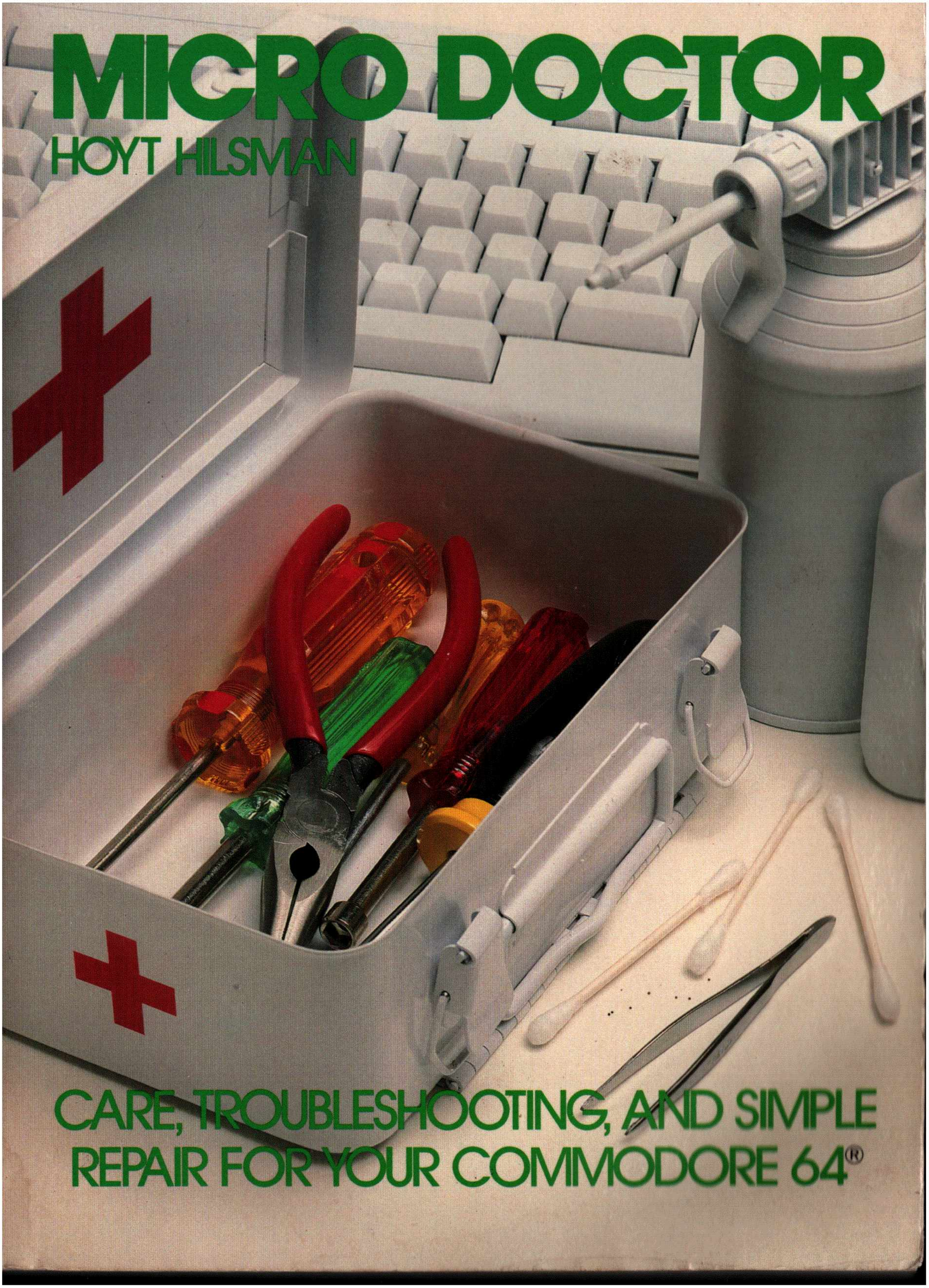
MICRO DOCTOR

HOYT HILSMAN



CARE, TROUBLESHOOTING, AND SIMPLE REPAIR FOR YOUR COMMODORE 64®

HILSMAN

MICRO DOCTOR

CARE, TROUBLESHOOTING, AND SIMPLE REPAIR FOR YOUR COMMODORE 64®

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MICRO DOCTOR

Care, Troubleshooting, and Simple Repair for Your Commodore 64®

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MICRO DOCTOR

Care, Troubleshooting, and Simple Repair for Your Commodore 64®

Introduction

Whether you've just bought your Commodore 64® or had it for a couple of years, the day will eventually arrive when *something will go wrong*. This is the terror that virtually all computer owners harbor deep in their hearts as they ask themselves, "What will I do?"

The purpose of this book is to answer that question. The book addresses the fears Commodore 64 owners have about the maintenance and repair of their personal computers. It discusses preventive maintenance, troubleshooting and repair techniques, as well as dealers, independent service companies, and Commodore itself.

The aim of the book is to provide a useful, nontechnical, comprehensive guide to the maintenance and repair of Commodore 64 computers for the average computer owner. It helps you solve the majority of repair and maintenance problems associated with personal computers and points the way for the Commodore 64 user seeking solutions to more complicated problems.

The Hidden Costs of Personal Computers

Repair and maintenance are among the greatest hidden costs of personal computers. Industry analysts estimate that some personal computer users will spend 15 percent to 20 percent of the purchase price annually on repair and maintenance of their personal computer systems. For systems that include such peripherals as printers and modems, this means an average repair bill of $150 to $300 a year for each system.

What can Commodore owners do to avoid these high repair and maintenance costs? This book outlines a three-tiered approach to keeping repair and maintenance costs under control, including:

1. Providing regular maintenance of key elements of the computer system
2. Troubleshooting and overcoming common problems
3. Using the Commodore warranty and the service plans offered by Commodore and others to your best advantage

Murphy's Law and Personal Computers

Murphy's Law states that whatever can go wrong will go wrong. For the most part, Murphy's Law does not apply to the operation of personal computers. Since their widespread introduction to the market a few years ago, personal computers have proved remarkably durable. This is primarily because, unlike most machines, computers do not have a large number of moving parts that are subject to wear and tear.

However, despite an excellent record of trouble-free operation, personal computers do have a number of trouble spots. Not surprisingly, these trouble spots often involve moving parts such as the disk drive, printer, or keyboard. Other problem areas include defective components, blown memory chips, and failing video screens.

The good news is that many of these problems can be repaired or prevented by Commodore owners themselves, who reap substantial savings on computer repair bills. The key to solving these simple problems is to take the commonsense, step-by-step approach to troubleshooting and repair described in this book.

The "Idiot Operator"

Computer service personnel report that 50 percent of their repair work is the result of "idiot operators" or "IOs," as they are disparagingly called. Idiot operators are those people who don't plug cords and cables in correctly, who drip milk shakes onto the keyboard, who get tangled in a maze of software problems, or who are just too lazy or busy to review the owner's manual. According to this definition, haven't we all been idiot operators at one time or another?

One of the goals of this book is to avoid becoming idiot operators, or at least to recognize problems and to solve them without spending hundreds of dollars on professional repair. With the help of this book, any reader should be able to prevent or correct the most common problems that crop up.

Learning Your Limits

Another aim of this book will be to tell you what you *can't* do. Professional service people spend a significant amount of time fixing computers that owners tried to fix themselves. Although those with a little knowledge of digital electronics may be tempted to tinker with their personal computers, there are definite limits to tinkering. For the most part, sophisticated repair can be done only by trained professionals with proper tools, parts, and diagnostic equipment. In the fast-moving world of microcomputer repair, components and diagnostics change rapidly, and the average computer owner can't hope to keep up with professionals, especially when repairs are complicated.

The secret to repairing and maintaining your computer yourself is to learn what you can do, and likewise to know when you're in over your head. This book tells you clearly when you've crossed the line.

Safety

Safety is a major concern in personal computer repair and maintenance. There is no reason to risk personal injury or damage to your system just to save a few dollars on repair. Virtually all repair and maintenance procedures discussed in this book are accomplished with power switches off and power cords unplugged. This is a cardinal rule of computer repair. Those foolish enough to ignore safety procedures risk disastrous consequences, both to life and limb and to the computer system.

The Philosophy of Repair and Maintenance

Now that you've heard the warnings about the limits of repairing and maintaining your Commodore 64 yourself, you should also get a taste of the philosophy of maintenance and repair. In general, the owner of a Commodore 64 can accomplish 90 percent of regular preventive maintenance and handle 50 percent of common repair problems.

Translated into dollars and cents, this means that a personal computer owner can save at least 75 percent of the repair and maintenance costs of an average system. The key to saving money on repairs is proper care and regular preventive maintenance. With good care and maintenance, most computer systems are largely trouble-free for five years or longer, depending on how much they are used.

When it comes to troubleshooting and repair, common sense is the basic philosophy. With this book as a guide, along with a little common sense, you can remedy most problems, even those that seem impossible to solve, without an expensive service visit. The secret of troubleshooting and repair is not to panic but to take a systematic, step-by-step approach to diagnosing and then solving the problem. This book outlines step-by-step troubleshooting for virtually all of the common problems with Commodore 64 computers and peripherals and gives solutions to these problems.

Maintenance and Repair Options

At the outset, it is important for Commodore 64 owners to know what options they have in maintaining, repairing, and servicing their computers. In fact, the choices are not simple, since there are many possibilities for maintenance and repair, ranging from Commodore or dealer service plans to self-maintenance and repair.

The aim of this book, in addition to providing a maintenance and troubleshooting guide, is to discuss in detail the maintenance, repair, and service options open to the Commodore 64 owner. Since the ideal approach to computer maintenance and repair integrates self-maintenance and repair with dealer and manufacturer support and service, it is important that Commodore 64 owners have an idea of what service options exist. This book is a resource guide for these service options.

Although the various maintenance and repair options are discussed at length later in the book, a brief look at these options provides a useful overview of the often bewildering world of personal computer maintenance and repair.

The First Line of Defense: Dealers

Whenever something goes wrong with a Commodore 64 computer, the first thing most computer owners do is call the dealer who sold them the machine. This is a natural reaction but not always the most satisfactory solution to the problem.

Commodore dealers are the first line of coverage, some would say defense, for support of Commodore products. Their primary business, of course, is selling computers. Many dealers provide comprehensive, thorough support for Commodore 64s. They are generally well trained, efficient, and familiar with Commodore products. Dealers often have repair technicians on premises who have had some form of training in repairing Commodore computers.

In general, the problem with the support and service given by dealers is one of priorities. Their first priority is to sell computer systems. Somewhat below that is their commitment to support the systems they sell.

Part of the problem with dealer support is the growing number of Commodore 64 systems being sold. With all those Commodore 64 computers out there, it is increasingly difficult for dealers to adequately maintain and service all the systems they sell. As a result, maintenance options that provide Commodore 64 owners alternatives to dealer service are rapidly developing.

Commodore Warranty and Service

Commodore has a standard ninety-day warranty plan covering all labor and parts for repair of Commodore products. If a problem develops with your Commodore 64 during the ninety-day warranty period, you can call the dealer who sold you the system and have it repaired. Or you can return it directly to Commodore for repair.

After the ninety-day warranty expires Commodore provides for factory repair of its computer products for fixed fees, which may not exceed a maximum amount per repair. This service plan is discussed in detail later in the book.

Independent Service Companies

A number of large, national third-party (not connected to any computer manufacturer) service companies have grown up around the computer industry. These companies are now turning their attention to the lucrative personal computer maintenance market.

The third-party companies specialize in service and repair of computers and generally offer quicker service at competitive or lower rates than dealers or manufacturers. These companies compete with each other for the fastest turnaround in repair time and the lowest rates and, for this reason, are an attractive alternative. Although most of the large, national firms do not yet offer repair services for Commodore computers, they will begin doing so as they expand.

In the meantime, a growing number of smaller independent service companies do offer repair and maintenance services for Commodore computers. They range from large firms to small, one-person operations and frequently offer cost-saving alternatives to dealer or manufacturer repair.

What the third-party firms do *not* provide are the support systems that Commodore and its dealers can give their customers. By and large, the third-party firms are hardware specialists and are therefore of very little help when a software problem arises.

The Cost of Repair

Costs for on-site service average about $100 per visit. And the cost of repairs at the dealer's shop are also expensive—$40 to $60 per hour, plus parts. Since most service personnel are trained to replace units at the drop of a hat, the costs can go much higher.

Commodore's own factory service plan is relatively inexpensive compared to the going rates for dealer repair. For a specified charge, Commodore will repair or replace components of your system. However, you have to ship the system back to the factory, and shipping can be somewhat expensive. In addition, sending computers back to the factory for repair means delay in its return. If you rely on your computer to do daily or even weekly work, this is a major inconvenience.

The Cost of Dealer Service Contracts

Although Commodore does not provide service contracts on its computers after the ninety-day warranty expires, many Commodore dealers offer their own service contracts, which generally cover one year of labor and parts. Service contracts generally cost 10 percent of the system cost annually. For example, a service contract for a $1,000 system costs $100.

Doing Your Own Maintenance and Repair

Even if you decide on one of the options outlined above—dealer, manufacturer or independent service plans—you may still want to do some of your own maintenance and repair. In fact, no matter what maintenance option you choose, you should undertake some care and preventive maintenance on your own.

Many computer owners feel that it's tough enough to figure out how everything works and how to get the most out of the computer without doing maintenance and repair on top of it all. However, maintaining computers is really no more complicated than maintaining any other machine, and self-maintenance shouldn't be a cause for fear and trepidation.

Levels of Self-Maintenance

Several levels of self-maintenance and repair are possible, depending on the confidence and expertise of the owner. The most basic level of self-maintenance is simply proper care of the computer. Proper care entails very little active maintenance; rather, it means taking simple precautions to prevent damage to the system or the data stored in it.

At the next level, preventive self-maintenance involves the regular cleaning of various elements of the Commodore 64 system, including the computer console, the keyboard, the cassette recorder or disk drive, and the printer and other peripherals. In addition to doing self-maintenance, Commodore 64 owners can make a number of fairly simple repairs themselves without a great deal of knowledge or expertise and with the minimum intrusion inside the system.

Finally, the owner can attempt a number of more complicated repairs, such as replacement of chips and components. This book touches on them briefly. Such repairs, however, are by no means the main thrust of this nontechnical guide for Commodore 64 owners.

Proper Care

Probably the easiest and most important self-maintenance is proper care, rather than active maintenance. Elements of proper care include choosing the right spot for your computer (away from direct sunlight, for example); keeping it in a relatively clean, dust-free environment; and keeping drinks, foods, and other potential hazards away from the computer. Other proper care precautions include simple safety measures to protect your Commodore 64 from static electricity and power surges.

Each element of your Commodore 64 system has specific care requirements, which range from dusting the monitor regularly to cleaning the disk drive heads. All the proper care procedures outlined in the book are simple, nontechnical chores that preserve the health of your system.

Preventive Maintenance

Preventive maintenance, as distinguished from routine care, involves cleaning, lubricating, and otherwise maintaining your system to prevent future problems and huge repair bills. Although some preventive maintenance procedures do require working on the "insides" of the system, you can do many of the preventive maintenance routines outlined in this book without opening up the system.

Regular cleaning is probably the best way to avoid big repair bills and keep your system in good working order. Since there are relatively few moving parts in a computer system, the main danger comes from environmental agents, such as dust and other foreign matter, which can foul up the operation of your computer. Regular cleaning prevents this kind of trouble.

The Art of Troubleshooting

Troubleshooting is an art, but it doesn't take a technical wizard to figure it out. Stated simply, troubleshooting is recognizing a problem and then diagnosing its cause. Once you've made a diagnosis, you're more than halfway toward solving the problem.

In this way, troubleshooting a computer problem is much like treating a patient with an illness. The doctor examines the patient and determines what the symptoms are. Then, he or she considers several possible causes, makes a diagnosis, and prescribes a course of treatment. To a certain extent, the doctor treats the patient by trial and error, deciding from the patient's progress whether the diagnosis and treatment were correct.

Although computer troubleshooting does not require the technical knowledge or approach the human importance of practicing medicine, it does involve the same basic approach to problem solving, or troubleshooting—namely, analysis of symptoms, diagnosis, and course of treatment. This book is organized along this medical model, with troubleshooting areas discussed in terms of problem, cause, and solution.

Troubleshooting and Repair—The ABCs

The bulk of this book is devoted to troubleshooting and repair of the main elements of your Commodore 64 computer: the computer console, the video monitor, the keyboard, the tape or disk drive, the printer, and miscellaneous peripherals and software. A general chapter on the ABCs of troubleshooting is followed by chapters that spell out the specifics.

The chapter on the ABCs of troubleshooting and repair discusses the philosophy and general techniques of personal computer troubleshooting and repair. Included in this chapter is a section on diagnostic techniques and aids, including diagnostic software. This book helps you to find diagnostic software that meets your needs and to use that software to best advantage.

The chapter on ABCs also covers basic tools and safety procedures for personal computer troubleshooting and repair. Both the tools and the safety procedures are absolutely essential to efficient and safe troubleshooting and repair.

Step-by-Step Guides

Several chapters of this book are step-by-step guides to the troubleshooting and repair of specific elements of your Commodore 64 system. Each chapter covers a particular element, including the console and keyboard, monitor, disk drive, and printer.

The step-by-step chapters are organized in a similar format for easy reading and reference. Each chapter begins with a description of a system element for easy orientation. The next section discusses common symptoms of trouble in that system component. Each of these common symptoms is described in detail.

After you pinpoint the symptoms, the next step is to diagnose the problem. A total lack of power, for example, could indicate anything from an unplugged cord to a serious electrical problem. Each diagnosis, of course, suggests a specific course of treatment. Specific remedies appear in the section on step-by-step solutions to the problem. Finally, each chapter describes simple repairs that most users can make themselves, as well as more advanced troubleshooting and repair procedures for more knowledgeable owners.

Resources

In addition to being a step-by-step troubleshooting and repair guide, this book is also a comprehensive guide to resources in the personal computer repair and maintenance field. Toward this end, the book includes appendices with a variety of information on maintenance, troubleshooting, and repair resources.

2

Proper Care

The best way to save time, money, and hassles on the maintenance and repair of your Commodore 64 is to take proper care of the system in the first place. It doesn't take much effort to place your Commodore 64 in a healthy environment and to protect it from accidents, power surges, and other problems that could damage your system.

Personal computers in general, and the Commodore 64 computers in particular, are well-made, durable machines that should be relatively trouble-free for a number of years if properly cared for. This means choosing a suitable location for your computer, protecting it from environmental or power source accidents, and doing a few routine maintenance chores to keep the system in good working order.

This chapter focuses on the proper care of your Commodore 64, including the proper environmental controls on light, temperature, humidity, dust, static electricity, and other factors that can affect the operation of your computer. It also discusses power sources and ways to prevent accidents from surges, brownouts, and other power irregularities. Also, it stresses commonsense prevention of tragedies caused by spilled drinks, blocked ventilation outlets, and the like.

In addition, this chapter outlines regular maintenance procedures for the care of your computer. These include regular cleaning of the console, keyboard, cassette recorder or disk drive, and peripherals. This chapter also discusses maintenance procedures that can nip a developing hardware problem in the bud, before it has time to blossom into a full-blown system breakdown.

The Environment

Unlike the older, larger mainframe computers that required highly controlled, dust-free environments in which temperature and humidity were strictly regulated, personal computers can operate in relatively uncontrolled environments, provided that the conditions are not extremely hot, cold, humid or dusty.

As a practical matter, your Commodore 64 will operate perfectly well in any room that is not extremely hot or dusty. However, if you use your Commodore 64 in a factory or other location that is dusty, smoke-filled, or subject to extremes of heat or cold, then you may be facing maintenance and repair hassles and high service bills.

This section discusses various environmental factors to check when you place and operate your Commodore 64. They include light, dust, temperature, static electricity, and other environmental conditions.

Light

When deciding on a spot for your Commodore 64 system, don't choose one that gets direct sunlight. Although it takes extreme heat to damage your system, it isn't worth the risk, especially to vulnerable items like diskettes, which can warp in direct sunlight.

Because most computer users prefer subdued lighting when using a video display terminal, try to find a spot in the home or office that does not get direct sunlight. Also protect your system from other direct, heat-generating light sources.

Dust

Although it is impossible (and unnecessary) to provide a dust-free environment for your Commodore 64 system, try not to place it in a particularly dusty area or near a duct from a gas or electric furnace. And make every effort to keep your system relatively free of accumulated dust by cleaning the surfaces regularly.

Regular cleaning is particularly important in factories, construction sites, stores, or other dusty and smoked-filled locations. In particularly dusty locations, the system should be dusted daily, especially the video terminal, which attracts dust, and the ventilation outlets and keyboard, which are vulnerable to clogging from dust.

Accumulated dust can cause problems in various parts of your system. For example, a heavy accumulation of dust or other foreign material in the computer console can cause shorts or other electrical problems that can foul connections or damage chips.

Dust in your cassette recorder or your disk drive can also cause serious problems. Disks and disk drives are particularly vulnerable to damage from dust particles on the surface of diskettes. Just a tiny dust particle can damage the diskette or cause the disk drive to malfunction.

Dust covers, if regularly used, can prevent some of these problems. However, use of dust covers is not a substitute for regular cleaning and maintenance. Some manufacturers of reasonably priced dust covers are listed in Appendix B.

Proper care of tapes and diskettes is also important in keeping dust out of the cassette recorder or disk drive. Tapes should be stored in boxes and diskettes should always be put back in their covers after use. It is also a good idea to store diskettes in closed containers to cut down on their exposure to dust and other hostile environmental elements.

Smoke

Cigarette smoke and the byproducts of smoking—ashes and cigarette butts—can also be hazardous to your computer. Smoke particles pose a real threat to disks, since particles on the disk surface can damage the disk itself. Although you don't need to enforce a no-smoking rule around your computer, it is a good idea not to let your computer room become choked with smoke.

Temperature

There are many theories about the proper operating temperature for a microcomputer. However, the commonsense approach is to avoid operating your computer at extremes of temperature. The problem, of course, comes in defining *extremes*.

Few people are comfortable sitting in front of a computer in subfreezing or even moderately cold temperatures. And except for the problems associated with static elctricity (which are discussed in detail later in this section), the computer would probably function as well or better than the human operator. So extreme cold presents less of a problem than extreme heat.

As a rule of thumb, many computer users consider 85° Fahrenheit or above to be a risky temperature at which to operate a computer. In addition, high temperatures may mean local or regional blackouts or brownouts in many areas of the country; these, of course, mean loss of computer function.

Many computer owners solve the problems of temperature extremes by air conditioning the room in which they use their computers. For those who work regularly on their computers, this solution is also sensible from the viewpoint of personal comfort. However, air conditioners and other heavy appliances should not be placed on the same circuit as the computer system, which should have its own dedicated line. (See the discussion of dedicated lines and other power requirements later in this chapter.)

Other causes of overheating could be as simple as placing a computer near a heating unit or having insufficient ventilation in the room. For the most part, however, the rise in temperature should be obvious to the computer operator, who can take such precautions as backing up disks or shutting the computer off.

Another, less obvious cause of overheating is the negligent blocking of ventilation outlets. If a diskette, a book, an article of clothing, or anything else is put over the ventilation outlets, the computer will heat up and begin to show signs of distress. The solution to this problem, of course, is to turn the system off and remove whatever is blocking the ventilation outlets.

Humidity

Humidity is not generally a problem for personal computers. Moisture, however, can be a big problem. For example, if your computer is sitting under a leaky pipe, you can expect major damage from electrical shorts, rust, and other problems. Fire sprinklers or other appliances that might spray water into your computer can cause similar problems.

Obviously, any liquid that gets into the computer console, keyboard, disk drive, printer, or any other element of your Commodore 64 system can wreak havoc. Later in this section, I will discuss accidents, including spilled drinks, which probably account for more repair problems than any other single computer maintenance issue.

Static Electricity

We all know what static electricity is, having all experienced the jolt that comes from touching a piece of metal after walking on a rug on a dry day. You probably didn't know that this surge of static electricity, which you feel as merely a "shock," is enough to disrupt the operation of your computer or even damage the system.

One effective way to protect your computer from static electricity as well as other electrical jolts is to ground the system properly. In fact, proper grounding of your system is an essential safety requirement.

Another defense against static electricity is to touch some grounded object before you sit down at the computer. This ensures a discharge of static electricity if you've been pacing around gathering static shocks.

Finally, many manufacturers, including Commodore, recommend using antistatic mats or rugs underneath and around your computer. In addition, antistatic sprays cut down on static electricity on rugs or other surfaces. Several companies, listed in Appendix B, manufacture these antistatic devices. Most computer manufacturers also recommend that you operate your computer in a room with a bare floor rather than a carpeted one, although antistatic devices seem to prevent dangerous buildup of static electricity even in carpeted rooms.

Static electricity is not the only potentially disruptive force. Magnetism can jumble or destroy the data on your diskettes. Therefore, it's a good idea to keep your diskettes away from operating machines, even ordinary household appliances like your telephone, television, or typewriter.

Power

Perhaps the single most important feature in the operation of your Commodore 64 is the power source. For example, if you work in an office with machines that make heavy power demands, your Commodore 64 may have problems associated with inconsistent power. Even common household appliances can drain the power away from your computer or subject it to sudden surges.

You can take several precautions to protect your Commodore 64 system from power problems. These range from finding a dedicated line for your computer to buying special equipment that ensures a steady, even flow of power.

Some of these procedures, such as providing a dedicated power line, do not generally involve great effort or expense (unless rewiring is necessary). However, some of the power regulating equipment may cost from $50 to $500. Obviously, if you are not having problems with your power source, then it probably isn't worth it to invest in expensive protective devices. But if power is a problem, then the following section should give you an overview of what equipment you may need and what is available on the market.

Dedicated Line

No matter where you use your computer, you should try to have it on a dedicated line so that no other machines or appliances compete with your computer for electricity. Although most personal computers function smoothly with some other appliances on the circuit, there is always the danger of overloading the circuit. For this reason, it's a good idea to dedicate one circuit to your computer alone.

It's fairly simple to find a dedicated line for your computer. For example, if you set the computer up in your den or study, simply check the circuit breakers or fuse box to discover what other rooms, if any, are on the same circuit as the den. If part of the circuit also goes to the kitchen or a bedroom, make sure that no other heavy appliances are on the same circuit as the computer.

It is also not a good idea to load up the circuit with appliances, such as air conditioners or office machines, even if you intend to use them in your computer room. To be safe, find an alternative power line for these machines and dedicate one circuit to the computer alone.

Grounding

Computer systems should be properly grounded, not only for the protection of the system but also for your own personal safety. The Commodore 64 system is equipped with standard, three-pronged plugs that fit into normal household outlets. If you don't have three-hole, grounded outlets, you may be able to use adapters; however, it's a good idea to have an electrician or the power company take a look at your wiring before you use adapters.

Power Problems

A variety of power problems, from very brief increases or decreases in voltage to major blackouts, can affect your computer. And you can take a number of measures to prevent damage to your system from these phenomena, but first you have to understand what these power problems are.

The first category of power problems is fluctuations in voltage, caused either by demand on the power or, more generally, by inconsistencies in the delivery of power by the power company. Several names are applied to different kinds of fluctuation, but they are generally called either spikes or surges.

Spikes are increases in voltage of short duration, only a part of a cycle. However, spikes can be very intense, causing problems for your computer. The opposite of a spike, that is, a voltage decrease of short duration, is called a *fault*.

Surges are also increases in voltage, but they last for a longer time. A comparable decrease in voltage is called a *dip*. Dips and surges can be dangerous because of their relatively long duration.

Spikes and surges have many causes, from lightning storms to the turning on of an electrical motor. Although your computer has some protection against sudden change in voltage levels, it is not usually enough to protect against all fluctuations. Therefore, some additional protection is a good idea, particularly if your power source is subject to problems.

Another power problem is electromagnetic interference, which causes noise. *Noise* is defined as extraneous signals superimposed on the power line and/or on your computer system. Noise has many sources, from radio or television signals to lawn mowers, and can disrupt the operation of your computer. The right equipment can solve your noise problems.

Brownouts and blackouts also present serious problems for computer users. *Brownouts* occur when hot weather or other unusual conditions force a power company to reduce the voltage to its customers. You can create your own "brownout" by putting an air conditioner or similar appliance on the same line as the computer. As I mentioned above, you can lose unstored data and perhaps even damage your computer system by not using a dedicated line.

Blackouts are total power failures, caused either by a failure of all power to an area or simply by overloading a circuit and tripping a circuit breaker or blowing a fuse. This kind of power failure will probably cause you to lose unstored data and may also damage your system.

Protecting Your System against Power Problems

What can you do to protect yourself against power problems? A number of products on the market, ranging from the relatively inexpensive to the very expensive, can protect you against the power problems described above. Table 2–1 summarizes the effects of these products.

Probably the best investment for a Commodore 64 in protection equipment is a *surge protector*. These devices sell for as little as $25 and protect against sudden increases in voltage (surges and spikes as described above). Surge protectors also provide considerable protection against noise on your power line. Many brands of surge protectors are on the market. A partial list of manufacturers of surge protectors appears in Appendix B.

There are other, more expensive power protection devices,

Table 2–1 Effects of Power Devices

	Noise	Spikes	Faults	Surges	Dips	Brownout	Blackout
Surge protector	OK	OK	None	OK	None	None	None
Line conditioner	OK	OK	OK	OK	OK	OK	None
Uninterruptible power supply	OK	OK	OK	OK	OK	OK	Varies

Line conditioners, which can cost $400 or more, deliver a steady, regulated supply of power and protect against both increases *and* decreases in voltage. This equipment protects not only against the physical damage caused by power increases but also against data loss as a result of power drops. Some manufacturers of line conditioners are listed in Appendix B.

More sophisticated (and expensive) equipment includes standby power systems, uninterruptible power systems (UPS), and emergency power generators. Although the needs of the average personal computer owner do not justify the cost of this equipment, they may provide much-needed protection for businesses, professionals, and others who stand to lose considerable money and time if valuable data were destroyed.

Accidents

Probably the greatest cause of damage to computer systems and important data are accidents caused by computer owners. These run the gamut from spilling drinks onto the keyboard to dropping the video terminal accidentally onto an errant skateboard.

You may be naturally accident-prone, but you can take some precautions to prevent costly accidents. First and foremost, *do not* drink anything around the computer. This may seem like a rather rigid prohibition, but it is the most certain way to prevent spilling liquid into the system and causing extensive damage.

If you must have a cup of coffee (or even something stronger) while working on the computer, put the glass or cup down where it won't tip over onto the keyboard, disk drive, or other parts of the system, including the diskettes. You may think you'll never knock that drink over, but chances are you will as soon as you lower your guard.

In case you do spill liquid onto your computer, *turn the system off immediately*. Once you've turned the system off, you can try to limit the damage by draining whatever liquid is still in the system. If it is plain water, you may get away without damage once the system dries out. If it's a soft drink, alcohol, or other beverage that leaves a residue, you should clean the system yourself or have it cleaned by a professional.

Although spilled liquids are the number one enemies of computers, cigarette ashes, dropped paper clips, pencil shavings, children's sticky fingers, and so on can wreak havoc with your system. The best policy is to keep these potential hazards as far away as possible when you are operating the computer. When the computer is not in operation, dust covers offer pretty good protection.

Most elements of the computer system are pretty rugged; however, it's not a good idea to test their limits by dropping them on the floor or tossing them about carelessly. Obviously, you can crack the video terminal or jolt connections in the computer console loose. You can also damage the cassette recorder, disk drive, and keyboard by mishandling them. Therefore, handle your computer system with care when you're moving it. And if you can't do it alone, get help.

Caring for Each Element of Your Commodore 64 System

Although there are general rules for caring for your entire Commodore 64 system, each element of the system has special requirements for proper care. The following section sets forth the special care and maintenance needs of the computer console, the keyboard, the tapes and cassette recorder, the disk drive and diskettes, the printer, and other equipment that may be part of your Commodore 64 system.

It is important to know the problem areas of each element of your computer system and to perform regular maintenance on the different elements. Proper care and regular maintenance go a long way toward preventing problems and, ultimately, avoiding costly repairs.

Commodore 64 Console

The computer console, the "brains" of your computer, is the most important element of your system. Fortunately, the computer console is generally the most reliable part of your system. It has few moving parts that might develop problems, and most of the trouble with consoles comes from faulty connections, failing chips, bad circuit boards, or similar electronic problems.

The most important care and maintenance requirement for the computer console is a good operating environment, relatively free of dust, temperature extremes, and excess moisture. In addition, a sufficient, steady power supply is crucial to the health of your console, whose microcircuitry can be damaged by power supply irregularities.

Dust the surfaces of your console regularly to keep dust from filtering through the ventilation slots into the interior of your system. Use a soft cloth lightly moistened with plain water or a mild household cleaner, such as a window cleaner. *Do not,* however, spray the window cleaner directly onto the console, since it could get inside the system and gum up the works. Spray the cleaner first on the cloth, then wipe the dust from the surface of the console.

If you operate your computer in a factory, construction site, or other particularly dusty environment, it is probably a good idea to clean the insides of your system regularly. You can either do this yourself or have it done by a professional. Since this involves opening the console, you may risk voiding your warranty. It is not a terribly complicated procedure, but you must be careful. (A step-by-step guide to cleaning your computer console appears in Chapter 3.)

Even if you use your computer in a normal household or office environment, you may need to clean the console periodically. This is particularly true if it begins showing signs of faulty connections, which are often caused by a buildup of dust or other foreign matter in the console.

Video Monitor

Whether you have a monitor manufactured by Commodore 64 or by another company, or even if you use an ordinary television set as a display terminal, the care and maintenance requirements are the same.

Both video monitors and television screens attract dust and need regular cleaning. Like the rest of the surfaces of the computer, the video screen can be cleaned with a soft cloth and an ordinary, mild household glass or window cleaner. When cleaning the back of the monitor, be careful not to spray cleaner directly onto the monitor, since you don't want it to get through the ventilation slots into the insides of the monitor.

Video monitors often develop display problems, which you can usually adjust by turning one or more of the display controls. Techniques for adjusting these controls, which set screen brightness, display width, and other display features, are discussed in Chapter 6.

It is also important to protect your video monitor from accidents and overheating. If you spill liquid or drop a foreign object into the video monitor, *turn it off immediately*. Then you can either clean the interior of your video monitor yourself or take it to a repair person. (Step-by-step instructions for cleaning your video monitor yourself appear in Chapter 3.)

Unless you encounter specific problems, it is not necessary to clean the inside of your video monitor regularly. However, if problems arise and you suspect the culprit is dust, dirt, or some foreign object lodged inside the monitor, then it might be a good idea to clean the inside. Of course, as with the console, you may void your warranty by doing so.

Keyboard

The keyboard is particularly vulnerable to dust, dirt, spilled liquids, and other intruding substances. The electrical circuits underneath each key are highly prone to shorting out and jamming.

The best way to prevent the buildup of dust and other foreign matter on your keyboard is to cover the keyboard when you're not using it. A number of dust covers on the market give good protection, provided, of course, that you use them.

You should dust the surface of the keyboard regularly. It is also a good idea to vacuum up the dust with a vacuum cleaner, but don't use the same brush you use to clean your rug or floor. Buy a special small brush designed for this job. There are also small vacuum cleaners that are specially made for cleaning computers.

To do regular cleaning and to dislodge small particles that may be jamming your keyboard, you can use dusters. Dusters are cans of pressurized inert gas; simply aim the duster at the offending keys to blow away the dust or dirt. You can purchase these cans of pressurized gas from computer stores, photography outlets, and similar retailers.

Also remember, as with other elements of your computer system, not to spray any cleaner directly onto the keyboard. Spray it onto a soft cloth first. This is particularly important when you clean the keyboard since liquid under the keys can spell instant disaster. Although you can remove the key caps and clean the contacts (see Chapter 3 for step-by-step procedures), you still may not be able to salvage your keyboard.

Cassette Recorders and Disk Drives

Cassette recorders and disk drives, like the other elements of your Commodore 64 system, need regular dusting, moderate temperature and humidity, protection from accidents, a dust cover, and so on. However, cassette recorders and disk drives have some additional care and maintenance requirements.

Disk Drives Because the floppy diskettes are stored outside of the system and can pick up dust, moisture, and other foreign material, you must clean the floppy disk drive regularly, particularly if you use the system a lot. In addition, the floppy disk drives must be precisely aligned for proper read/write operation, and their read/write heads must also be kept clean.

The primary way to keep your disk drive running smoothly is to take proper care of it. That means obeying all the rules about temperature, humidity, dust covers, and protection against accidents. In addition, always keep the latches on the disk drive closed except when inserting diskettes. This minimizes the amount of dust that gets into the system.

Care of diskettes is also a very important factor. If your diskettes are dirty or warped, they can interfere with the smooth running of your disk drive or even damage the system. Proper care of floppy diskettes is explained later in this chapter.

Although you should clean your disk drive regularly, how often you clean it depends on how often you use the system and how dusty the environment is. Systems with average usage in normal environments shouldn't need cleaning more than twice a year. However, if problems start showing up in the disk drive, a good first step toward solving the problem is cleaning the drive.

There are a number of theories on cleaning disk drives. One school of thought holds that drives should be cleaned by hand, rather than with one of the commercially available head-cleaning kits. This "purist" school argues that the cleaning kits are not as thorough; however, for the average computer owner, the kits do the job with much less hassle than cleaning the drive yourself or taking it to a repair service.

Head-cleaning kits for disk drives (see Figure 2–1) generally cost between $15 and $30. These kits usually include

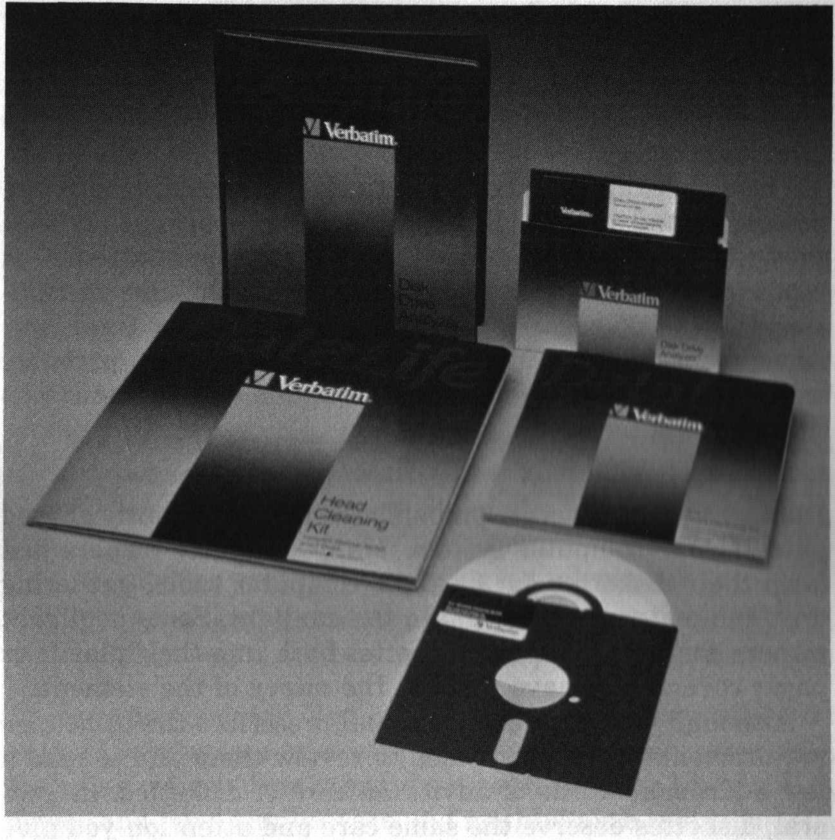

Verbatim
Disk Drive Analyzer
Verbatim
Verbatim
Disk Drive Analyzer
Verbatim
Head Cleaning Kit
Verbatim

FIGURE 2–1 A Head-Cleaning Kit

cleaning solution and a number of cleaning disks. Most kits last for about fifteen to thirty cleanings and may also include extras such as user software and manual. (A list of some manufacturers of head-cleaning kits for floppy disk drives appears in Appendix B.)

It is also important that your disk drive be properly aligned, since improper alignment can cause read/write and other problems. If you suspect improper alignment, take your drive in for professional repair.

A number of disk drive diagnostic programs can diagnose bad alignment. They are available either as separate products or as part of general diagnostic software, which can test read/write ability, alignment, speed, and other disk drive functions.

The advantage of these relatively inexpensive software packages, and of any diagnostic software package, is that they tell you what may be wrong so that you can tell your repair person and perhaps cut down on repair bills. In addition, they let you assess whether the repair person fixed your drive properly. At under $50, these packages are probably worth the investment. (See the discussion of diagnostic software in Chapter 4.)

Diskettes Diskettes are probably the most frequently abused part of your computer system. Many computer owners just keep their diskettes out on their computer table, gathering dust and moisture or baking in the sunlight. Some negligent owners don't even put the diskettes back into their plastic or paper covers, but leave them to the mercy of the elements.

Although your disk drive manual prescribes the basic care requirements, it is a good idea to review them and to read a few additional words of advice on care of diskettes. In general, diskettes deserve the same care and attention you give other parts of your system, that is:

1. Do not expose your diskettes to extremes of cold or heat. Temperatures below 50° or above 120° Fahrenheit may damage the diskette and/or the information stored on it. Don't, for example, leave your diskettes out in direct sunlight or on the dashboard of the car, where they will bake.
2. Use your diskettes in a clean place. Dust is a major enemy of diskettes, so be careful to use and store them in clean places. Don't leave them lying haphazardly on a dusty shelf or table, for example.

3. Store your diskettes in a plastic case. Specially designed hard plastic cases protect diskettes from the elements. Cases also protect them from some people's habit of stacking uncovered diskettes on top of each other.
4. Handle your diskettes with care. Don't touch the exposed surface with your fingers. And label your diskettes only with a felt-tipped pen. When inserting your diskettes into the drive, don't jam or force them. And don't try to clean your diskettes with a cloth or cleaner or anything else. They don't need to be cleaned, and trying to do so could damage them.
5. When mailing diskettes, package them carefully; when traveling with them, keep them away from metal detecting systems at the airport. In general, keep diskettes away from sources of magnetism, including seat belts and ringing telephones.
6. Always make backup copies of your disks or tapes so that you won't lose data if they are lost or damaged.

Cassette Recorders You may operate your Commodore 64 with a Datassette or other type of cassette recorder rather than with disk drives. Tape cassette recorders function like the disk drives and have similar care and maintenance requirements.

Like diskettes, cassettes must be handled carefully and are subject to damage from extremes of temperature and humidity, dust and dirt, smoke, spilled drinks, and other hazards. Like diskettes, cassettes should be stored in a covered container and packed securely for shipping.

Tape heads of cassette recorders need regular cleaning. The best solvent for cleaning tape heads is the kind used to clean ordinary cassette recorders. This solvent is available at most audio outlets.

Printer

Your printer has more mechanical components than the other elements of your system and is therefore more subject to wear and tear. In addition, your printer is more likely to be a "foreign" component (that is, not made by Commodore) and therefore may give you service and support problems.

All this adds up to the fact that proper care of your printer means significant savings in time and money. Like the other parts of your computer system, your printer should get a good workout while it is still under warranty. That way, you will discover minor problems that may develop into major hassles while somebody else is still paying the repair bills. And some printers, more than any other parts of the computer system, can be lemons. It is best to find this out while the warranty is still in force.

The printer has lots of places, especially moving parts, where dust, bits of paper, spilled liquids and other foreign objects can settle, causing eventual trauma to you and your system. A dust cover is the first line of defense against outside intruders. In addition, the usual rules about clean, temperate working environments apply to printers as well.

Dust the surface of your printer regularly, and also dust the accessible printing elements at regular intervals. In general, this means disassembling only up to the point described in your installation manual. You can usually remove the platen, thus gaining access to some of the areas underneath that can accumulate dirt, dust, and other foreign material.

Dust surfaces with a soft cloth and then vacuum with a small brush attachment to get out the dust in hard-to-reach places. You might also use a compressed gas duster to clean moving parts. It is also a good idea to clean the printing element regularly, depending on how much you use your printer. Typewriter cleaning kits are good for this purpose.

Lubricating your printer is also a good preventive maintenance measure. Although lubrication is a little more complicated, most computer owners can do this at home. A step-by-step guide to cleaning and lubricating your printer is found in Chapter 3.

One additional note on service contracts for printers: Since printers are often costly to maintain and repair, consider getting a service contract on your printer, even if you've decided not to purchase a contract for the rest of your system. Service contracts for printers are relatively inexpensive and are available from Commodore dealers and third-party service companies.

Software

As the market for software booms, software maintenance, service, and support are growing fields. In many cases, software problems can cause endless hassles, as well as "finger pointing" by hardware experts, who are quick to blame unexplained failures on the software.

The problem is that some software comes from small companies that are not equipped to back up and support their products. As a result, the customer may be left out in the cold when a mysterious software and/or hardware problem appears.

There is some hope: Because of the growing controversy in the industry over software problems, more attention is being paid to the maintenance and support of software. Most software companies now provide some form of warranty and support on their products. A few service companies are beginning to offer software support in the form of help lines and other services.

Another facet of software that every Commodore 64 user should keep in mind is copy protection. Most commercially available software for the Commodore 64 is now copy protected to avoid unauthorized duplication. Many copy protection systems direct the drive to skip sectors or perform other operations that can actually cause drive problems. For this reason alone, Commodore 64 users should never attempt to copy these protected programs.

Peripherals

There are dozens of different kinds of computer peripherals on the market today—from complex graphics and communications hardware to simple joysticks. I will not try to cover maintenance procedures for each of these products, other than to say that each requires at least the same general care as the other elements of your computer system—a reasonably clean, temperate environment protected from accidents, power surges, and other potential threats to the computer or the data stored in it.

3

Cleaning and Routine Maintenance

Even if your computer is in perfect working order, you still need to do regular cleaning and maintenance if you want to prevent future problems. Although you don't have to be fanatical about keeping your computer clean, you should periodically clean each element of your system, particularly if you use your computer a great deal or operate it in a dirty or harsh environment.

Of course, the best way to keep your computer system clean in the first place is to cover it when it's not in use. Using dust covers protects your system from dust, spilled liquids, and foreign objects.

Another way to keep your computer operating smoothly is to dust the external surfaces regularly, particularly those that attract dust, such as the video monitor, or that are vulnerable to dust or dirt buildups, such as the disk drive and printer.

You can vacuum the external surfaces of your computer regularly, provided you use a clean attachment and avoid bumping the computer too much with the vacuum cleaner. Some vacuum cleaners are made specifically for cleaning computers.

Proper care is the best way to ensure a long and trouble-free life for your computer. This includes providing a clean, temperate environment, adequate power safeguards, and regular cleaning and preventive maintenance. Chapter 2 contains detailed advice on how to take proper care of your computer system.

This chapter provides step-by-step procedures for cleaning and routine maintenance of each element of your Commodore computer, including the console, the disk drives, the cassette recorder, the video monitor, the keyboard, and the printer.

General Advice on Cleaning and Preventive Maintenance

Some people are obsessively clean and fussy about their possessions. Others are, frankly, slobs who couldn't care less. If you are somewhere in between, as most of us are, you may want to know how often you should clean your computer system.

There are no hard-and-fast rules; however, a thorough, twice-a-year cleaning of your system should be more than sufficient to keep it operating smoothly and to prevent any serious problems due to the buildup of dust and dirt.

In some cases, though, computers require more frequent cleaning. For example, if you give your computer heavy use or operate it in a particularly harsh environment then you have to clean it more often.

One repair technician I know reported that he had to clean a client's computer twice a month because an extreme build-up of dirt and dust was interfering with the operation of the system. I was a little surprised until I discovered that the computer was at a construction site.

Even if you don't operate your computer at a construction site, you may have to clean your system frequently if you give it heavy use. You may also find that certain elements of your system need more attention than others. It may not be necessary to clean your console more than once a year, but your disk drives or printer may need more attention.

For example, one of the most common problems with disk drives is dirty read/write heads. With the head-cleaning kits that are available on the market, it is a simple matter to clean your disk drive heads regularly. This is particularly important if your disk drive begins to malfunction.

Printers may also require more frequent cleaning, since bits of paper, dust, and foreign objects can settle in the mechanical parts and jam the works. Regularly cleaning and lubricating your printer is essential to its smooth operation and long life.

Self-Maintenance versus Professional Service

Even if you don't want to do any regular cleaning or preventive maintenance yourself, you should make sure that somebody does it, preferably a professional service person. Although Commodore's warranty and dealer service agreements do not automatically include cleaning and preventive maintenance, cleaning and maintenance should be provided with all repair procedures.

If you don't want to do the regular cleaning and maintenance yourself, then you should take the system in for a complete cleaning and checkup at least once a year or more frequently if you use the system a lot. Even if you take the computer in for a minor adjustment or repair, ask the technician to clean the system as part of the repair. Cleaning might cost you a little more in repair time, but it will cut down future repair bills.

If you decide to undertake periodic cleaning and maintenance yourself, then you can follow the step-by-step cleaning and maintenance procedures in this chapter. However, if you don't want to do the more complicated chores yourself, you can always leave those chores to a professional.

The simplest and most important cleaning procedures, besides regular surface dusting and the other proper care procedures outlined in Chapter 2, are vacuuming the printer and keyboard and cleaning the heads of the disk drive or cassette recorder. These procedures require a minimum of effort and go a long way toward prolonging the life of your Commodore system.

Safety

When doing any personal computer repair or maintenance, you must take a few important safety precautions. First and foremost, you must *always work with the system turned off and unplugged.*

This is the most important rule to follow, since working with the power on can result in injury to yourself and damage to the computer system. So always begin by turning off all the power switches and unplugging all elements of the system.

For the safety of your computer, you should also be careful to keep all liquids away from the system. If you are using alcohol or another cleaning liquid, put a little bit on a rag or swab, being careful to keep the bottle away from any part of the system.

If you use a standard household vacuum cleaner, be sure to use a clean attachment and to be gentle when poking it around your computer. It is, of course, preferable to use a vacuum cleaner that is specially designed for cleaning computers.

Tools

In addition to basic tools such as screwdrivers and wrenches, you will also need some other tools specifically for cleaning your system. For exterior cleaning, you can use a vacuum cleaner with a clean, brush-type attachment. A household vacuum cleaner, however, should be used only for exterior cleaning.

You will also need clean rags, swabs, and a bottle of isopropyl alcohol. Use only high-grade alcohol and stay away from other household cleaners, which can wreak havoc with your system.

Another essential tool for cleaning a computer is a can of pressurized inert gas for blowing out the dust from nooks and crannies. You can buy this product, which is described in detail in Chapter 2, from most computer, electronics, or photography stores.

You may also find a teflon lubricant and an electronic contact cleaner useful, though not essential items. These are available at most computer and electronics stores.

Head-cleaning kits are an essential item for cleaning disk drives. Although some people argue that they are not as effective as manual cleaning, they are certainly easier and more convenient for the average computer user.

Step-by-Step Cleaning

The following sections set forth step-by-step procedures for cleaning each of the the elements of your Commodore system, including the console, the disk drive, cassette recorder, the video monitor, the keyboard, and the printer.

The most important thing to remember as you clean your computer is to proceed systematically and deliberately. For example, when you remove screws from the external cabinet of the console or other system element, be sure to set the screws aside in a jar or some other safe place, where they won't get lost or mixed up with other parts.

Proceed slowly when taking the system apart. Remember that computers are delicate electronic instruments; bending, jostling, or pounding is not good for the circuitry. Never force any part. Try a lubricating spray first. If that doesn't work, try using a different tool. Above all, don't use force; you might break part of the system.

Cleaning the Commodore Console

The console is one of the more difficult elements to clean because you need to open the system cabinet and clean delicate electronic circuitry. For that reason, you should follow the step-by-step instructions carefully and treat the circuit board and other components with care.

If you are uncertain about cleaning your console yourself, don't do it. It is probably the least necessary cleaning procedure, since most computers don't get the kind of wear and tear that calls for cleaning the console more than once a year. If you doubt your ability to clean the system, leave it to a professional repair person.

Another reason for proceeding with caution is that you may void your Commodore warranty or service contract if you open the console to clean it or make repairs. Although simply opening the console does not necessarily void your warranty, you may have to pay for any repairs caused by your mistakes or negligence. With these cautionary words in mind, follow these step-by-step procedures for cleaning your Commodore console:

1. Turn off the power. Unplug and disconnect all cables to the console.
2. Remove the three screws from the bottom of the cabinet. Gently lift the cabinet top and the keyboard from the bottom of the cabinet.

3. Disconnect the keyboard connector (left side of unit) and the power indicator connector (upper right side of unit) from the main board.
4. Remove the cabinet top and keyboard.
5. Inspect the console for any obviously foreign objects that might have fallen into the unit. There shouldn't be any such foreign objects, but if there are, remove them with caution, being particularly careful not to jostle any of the cards or other circuitry. You might even use tweezers for this job.
6. *Gently* vacuum the areas that are easy to reach with a clean brush attachment.
7. Use a can of pressurized gas to remove accumulations of dust or dirt. You can point the can fairly close to the console without harming it.
8. After you blow away all the visible dust, spray an electronic contact cleaner over all the circuits. Once you have sprayed the cleaner on, *don't wipe it up*. It will dry by itself, and you won't run the risk of leaving lint from the rag or cloth on the circuits.
9. You have now completed the most important part of the cleaning and can close the console at this point if you wish. If so, go to step 11. However, you might also want to clean the system's internal connectors.
10. You will notice a number of internal connectors, such as the keyboard connector, which are fairly easy to clean. After unplugging them (remembering not to force anything), spray a small amount of electronic contact cleaner into the connectors and sockets, and then replace the connectors.
11. Making sure all connectors are back in place, you can either replace the console cabinet or proceed to the next section on cleaning your keyboard.

Cleaning the Keyboard

The keyboard is vulnerable to dust, dirt, and accidental spills. All these can make the key contacts dirty, causing the keyboard to malfunction. The best way to prevent an accumulation of dust is to keep the console covered when it's not in use and to dust the keyboard regularly with a pressurized gas duster.

However, if your keyboard begins to malfunction, you may have to remove the keyboard from the console and clean the contacts themselves. In fact, it is a good idea to do this anyway at least once a year (or more frequently if you operate your computer in a dirty or dusty environment).

If you spill liquid into the keyboard, turn the system off immediately and follow the steps outlined in "Spilled Liquids," below. To prevent that kind of accident, read the sections in Chapter 2 on proper care of your keyboard.

1. Remove the three screws from the bottom of the console cabinet.
2. Lift the cabinet top and disconnect the keyboard connector and power indicator connector from the main board.
3. Remove the eight screws that attach the keyboard to the cabinet top and lift the keyboard assembly.
4. Begin by thoroughly dusting the keyboard assembly with a gas duster.
5. Examine each key switch to make sure no foreign object, dirt, or dust is interfering with good contact. Then carefully clean each key contact with a key switch cleaner.
6. Replace keyboard assembly and console.

Spilled Liquids If you have the misfortune to spill liquid (even a glass of water) on your keyboard or console, you can take a few steps to salvage it. Although the odds are that you will have to replace the console or keyboard, the following section gives you a step-by-step salvage procedure.

1. Unplug the computer immediately. This is particularly important since shorts could damage your system and even injure you.
2. Drain any liquid remaining in the console and keyboard by tilting the unit so the liquid flows *away* from any unaffected keys *and* the main board.
3. If possible, remove the console cabinet following the procedures above for cabinet removal and gently soak up any remaining liquid with a *clean* cloth.
4. Use the pressurized gas duster to dry any wet parts.
5. Replace the cabinet and set the console aside to dry out for at least forty-eight hours.
6. Test the console and keyboard. If the system works fine, you were lucky. If there is a problem with the console or keyboard, try cleaning them again. If that doesn't solve the problem, have the system professionally repaired.

Cleaning the Disk Drive

The most important parts to clean are the drive heads; however it's also important to keep the drive mechanism free of dust and dirt. The following section describes procedures for cleaning the drive mechanism.

Drive Mechanism

1. Turn off the power and unplug the computer.
2. Make sure that the disk drive cord is unplugged.
3. The bottom of the drive cabinet is held to the top by four screws. Remove those screws.

4. Remove the two screws on the side of the chassis that hold the shield over the main board.
5. Remove the six screws that attach the chassis from the bottom of the cabinet and lift the chassis from the cabinet.
6. Carefully remove any foreign object in the disk drive. Use tweezers if possible.
7. Use a pressurized gas duster to blow away dust in the drive.
8. At this point, a professional technician might remove the drive to clean the heads, lubricate the mechanism, and check for worn parts. However, unless you are having specific problems with your drive *and* feel competent to do the necessary lubricating, you should consider the job done and replace the disk drive cabinet.

Drive Heads Unless you have particularly expertise and confidence in working with disk drives, you should use the easy and convenient method of cleaning your drive heads—a head-cleaning kit. Follow the instructions in your head-cleaning kit carefully.

Cleaning the Cassette Recorder

If your system includes a cassette recorder, you need to give it the same careful attention and cleaning you would give to a disk drive. At the minimum, you should clean the tape compartment and the tape heads twice a year. You should also clean inside the tape recorder if specific problems develop.

1. Remove the lid of the tape compartment.
2. Clean it with a pressurized gas duster.

3. With a cotton swab dipped in alcohol or head-cleaning solution, wipe the tape heads, changing swabs until they no longer show dirt (or clean the heads with a commercial head-cleaning kit).
4. To clean the inside of the recorder, remove the cabinet and dust with a pressurized gas duster. You may also want to apply some teflon-based lubricant to the moving parts.
5. Replace the recorder cabinet.

Cleaning the Printer

Printers usually get dirtier and require more preventive maintenance than any other element of your computer system. That is because printers have more mechanical parts that require lubrication and because they are more open to dust, dirt, and foreign objects than other parts of the system.

Printers should be cleaned and lubricated twice a year, particularly if they get heavy use. They should also be regularly dusted and vacuumed to make sure dust doesn't built up in the system.

Investigate the first sign of mechanical trouble in your printer, since printer problems tend to snowball. Jammed paper, paper clips, and other physical impediments are often the source of mechanical problems, so it is wise to keep a sharp eye out for things that go bump in your printer.

The printer mechanism can also get out of alignment. Most alignment procedures are best left to your repair technician; however, you can check to see that the print wheel, carriage, and platen are correctly positioned. If there is a problem, it's best to take the printer for repair immediately.

The following section sets forth step-by-step procedures for cleaning and lubricating your printer. Obviously, there are many different brands of printer, but most have the same general construction. These instructions apply to most printers on the market.

Procedures for dot-matrix printers are somewhat different from those for daisy-wheel printers. Differences are noted in the step-by-step instructions.

1. Turn off and unplug the printer.
2. Remove the top of the printer cabinet.
3. Wipe the areas that are easy to reach, such as the platen and carriage support, with a clean cloth.
4. Remove any foreign objects, such as bits of paper, that could jam the works. Use tweezers if necessary.
5. Use a pressurized gas duster to blow dust out of hard-to-reach areas. Avoid simply blowing dust from one part of the printer to another, however.
6. Use a vacuum cleaner to clean up remaining dust and bits of paper.
7. You may also want to remove the platen and clean it with a clean cloth and special platen cleaner, which you can buy in your computer or electronics store.
8. If you have a daisy-wheel printer, remove the daisy wheel and clean it *carefully* with a clean cloth dampened with alcohol. If one or more of the letters are printing poorly, there may be a buildup of ink or dirt in the print head. Remove the buildup with a needle, applied *gently*. Clean a dot-matrix print mechanisms with a cotton swab and alcohol.
9. You may not want to lubricate your printer yourself, and you don't need to lubricate it every time you clean. However, if you decide to lubricate your printer, consult the manufacturer's manual, since lubrication procedures differ markedly.
10. Replace the printer cabinet.

Cleaning Your Video Monitor

Dusting the surfaces of your video monitor regularly and other commonsense care are the best ways to prevent problems with your monitor. (See Chapter 2 on proper care of your monitor.) However, if you wish to, it is a fairly simple matter to clean your video monitor.

1. Turn off and unplug your system, and unplug your monitor from the system.
2. Remove the monitor cabinet.
3. Vacuum the accessible areas with a clean brush attachment.
4. Clean other areas with a pressurized gas duster.
5. Replace the monitor cabinet.

4

The ABCs of Troubleshooting and Repair

Troubleshooting and repair of common problems are fairly simple, straightforward matters, provided you follow safety precautions and use common sense in deciding which repairs to tackle yourself and which to leave to professionals.

The troubleshooting and repair techniques in this book are designed for a general reader with no background in electronics or computers. Even the reader who doesn't know which end of a screwdriver to use should be able to profit from this book.

Most of the book is devoted to simple, everyday troubleshooting and repair of the problems that most commonly plague personal computers. The chapters on troubleshooting your disk drive and console involve some technical procedures, including voltage reading protocols, mechanical adjustments, and replacement of parts. The majority of procedures in this book, however, require no special knowledge or experience.

The aim of this book is to help the average Commodore 64 owner to save money on computer repair by doing regular cleaning, preventive maintenance, and simple repairs. The book does *not* transform the reader into a computer repair professional or even a competent hobbyist. Rather, it is a guide to cutting the repair costs on your Commodore 64.

The cardinal rule of the average computer owner should be, "You can't do it all yourself." Throughout this book, I repeat this message frequently, particularly when step-by-step troubleshooting techniques point to a serious underlying problem.

Every computer owner needs access to good professional repair, whether through a computer dealer, a third-party company, a small repair shop, or Commodore itself. The chances are good that you will need this professional resource at some point, even if it is only for some helpful advice.

By the same token, you should be familiar with basic troubleshooting and repair techniques even if you have a service contract with a dealer or a good relationship with a friendly computer repair person. Many service contracts do not clearly provide for preventive maintenance and routine cleaning, which can be the most important factors in keeping your system running smoothly. You should know how to provide minimum care for your computer system yourself, or at least be able to tell your repair person what cleaning and maintenance you want done.

Throughout this book, I stress the importance of a three-tiered approach to personal computer maintenance. These include: (a) regular cleaning and preventive maintenance, (b) troubleshooting and repair of simple problems by the owners themselves, and (c) adequate professional service backup, whether from the computer dealer, third-party company, or Commodore itself.

In short, you can't do troubleshooting and repair in a vacuum. You need to take regular, proper care of your computer in the first place. You also need to recognize your own limits and have access to a professional repair person for advice and service.

The Commonsense Philosophy of Troubleshooting and Repair

Troubleshooting and repair of personal computers, as any computer repair person will tell you, are pretty straightforward matters, provided you keep your wits about you.

After all, computers are reasonably durable machines, with few moving parts to wear out. And most of the problems are easy to diagnose and repair if you have the right tools and follow a systematic approach.

Unfortunately, it is hard for some people to follow a systematic, step-by-step approach. Most of us don't learn the basic lesson of troubleshooting and repair—common sense—until we've tried to fix something once and fouled it up hopelessly.

Fighting the Urge to Panic

For the most part, the average inexperienced computer owner rushes into a frenzy of repair, often leaving parts strewn around the desk and the computer in several pieces.

This kind of frenzied repair is usually the result of the panic that strikes many of us when something goes wrong with the computer. Computer problems invariably crop up at the worst possible time—the day before the big memo is due or the night Junior has to type up his term paper.

The frustration over a failing computer leads to the panicked question, "What am I going to do?" The answer is often an ill-advised rush to repair the #*!? thing. Frequently, the would-be repair person ends up more frustrated and panicked, with a computer that is in no better shape, or sometimes even worse off, than when it first broke down.

The first principle of computer troubleshooting and repair is, therefore, don't panic. This is easier said than done, since panic is the natural human response to something as maddening as a computer malfunction. However, if you succeed in fighting panic, both you and the computer will be better off in the long run.

Rather than rushing pell-mell into pulling the system apart, begin by trying to assess the problem. Observe as much as you can about how the computer is behaving before you start ripping out the insides of your system.

It is even a good idea to jot down a few notes about what the computer is doing or not doing, as well as when and how the problems started. This step may seem tedious, but it helps to sort out the sometimes complicated range of problems. It also helps you control panic and begin to get a handle on the problem.

The Medical Analogy

Computer troubleshooting and repair adhere, to some extent, to a medical model. Although troubleshooting is not as complex as medicine, it follows an analogous technique of isolating and identifying symptoms, venturing diagnoses, and prescribing courses of treatment.

Computer troubleshooting, like medicine, involves three basic distinct steps:

1. Isolating and identifying the problem or symptom
2. Formulating a diagnosis, or theory, to explain the symptom
3. Prescribing and following a course of treatment

Although this approach is only a rough framework for computer troubleshooting and repair, it is a useful way to understand troubleshooting procedures and techniques. If you approach troubleshooting in this systematic, step-by-step way, you are also less likely to panic and rush into ill-considered repairs.

Taking the medical analogy a step further, you have to develop a good "bedside manner" when your computer develops problems. Rather than flying into a panic of rage and frustration, adopt a systematic, low-key approach, considering the options for self-repair versus professional repair as well as the step-by-step troubleshooting techniques outlined in this book.

Although I do not advocate comforting your computer as a doctor comforts a patient, I do recommend a compassionate approach to your computer's problems. After all, your computer has probably already done yeoman service on your behalf, working long and hard to perform minor miracles of word processing, gamesmanship, accounting, and the like. Doesn't it now deserve a little tender loving care in its hour of need?

Step-by-Step Troubleshooting and Repair

This book follows a step-by-step approach to troubleshooting and repair. Each of the troubleshooting and repair chapters discusses different elements of your computer system: the console and keyboard, the monitor, the disk drive and cassette recorder, and the printer.

The chapters briefly describe the functions and operation of each element of the system and include illustrations of each component. The bulk of each chapter, however, is devoted to step-by-step troubleshooting and repair techniques for the problems that most commonly plague that particular part of your system.

The troubleshooting and repair sections follow the same format in each chapter. First, they set forth a common problem of that element. The symptoms of this problem are then discussed in some detail, so that you, the reader, can isolate and pinpoint the symptoms, which often seem baffling at first.

The next step in the discussion of each problem is the diagnosis. The diagnosis section gives one or more reasons why the problem might arise. Like a medical diagnosis, this is a theory about the cause of symptoms; and like a medical diagnosis, it is based on the probability or likelihood of one or more specific causes.

Since it is merely a theory about the probable cause, the diagnosis may turn out to be wrong. However, as in medical science, the purpose of the diagnosis is to provide a theory, or framework, for treatment. Like a medical detective, the computer troubleshooter constructs a theory as to the probable culprit and then proceeds to rout the culprit out with treatment techniques. Even if the diagnosis is wrong, you learn something about the problem, and can then try another diagnostic theory.

The final part of this step-by-step troubleshooting and repair technique is treatment of the problem. Most problems suggest a number of possible treatments, generally beginning with the simplest and most obvious and progressing to the more complex and obscure. This sequence is deliberately designed to rule out from the start those obvious causes that are easiest to remedy.

As you proceed with step-by-step treatment of a problem, you may find that some of the suggested steps or repairs don't apply to your particular problem. Or you may be able to rule them out without actually applying the treatment. That is perfectly all right. The purpose of the step-by-step treatments is to give you a systematic approach to solving the problem, not to set up a rigid set of repair requirements.

As you look through the step-by-step troubleshooting sections, you will note that there is a pattern or methodology to troubleshooting techniques. For the most part, the sections begin by ruling out power supply or other obvious problems that plague most elements of your system.

Frequently, the next step is looking for dust, dirt, or foreign objects that may be jamming or otherwise disrupting the system. Usually, the treatment for this kind of problem is simple: Remove the foreign object and/or clean the system.

The final troubleshooting and repair techniques discussed in each section are repairing or replacing a mechanical or electronic part. In many cases, owners can make simple repairs themselves. However, in other instances, the book recommends asking for professional help.

Even when you suspect that you will need professional help, however, it is a good idea to go through the troubleshooting procedures. If you take the time to go through step-by-step troubleshooting, you will usually be able to arrive at an accurate diagnosis, which you can report to your repair person.

You will save lots of time and money if your repair person has a good idea of what's wrong with your system when you take it to the shop. Instead of spending time interrogating you about the problem or going through lengthy tests and troubleshooting, the repair person can spend his or her costly repair time actually fixing your system.

The chapters on troubleshooting and repair of the console and disk drive have additional sections containing fairly detailed procedures for testing and repairing those components that are most likely to give you trouble. These sections describe some advanced techniques in voltage testing and other procedures, which require specialized knowledge and special safety precautions. As the section below explains, you should not undertake these advanced troubleshooting and repair procedures unless you are confident *and* competent in electronic repair.

Safety

Most of the repairs described in this book should be done with the power off and the system unplugged. Since parts of your console and video monitor carry high power voltages, always turn off the system and unplug it before doing any repairs.

Some more complicated troubleshooting and repairs, such as voltage testing and other procedures, require that you work with the system power on. These can be accomplished safely if you carefully follow all the safety precautions described in this chapter and in the step-by-step procedures. However, if you don't feel comfortable working with the power on, then don't do it. It's much wiser to take complicated repairs to a professional service person than to risk injury to yourself or serious damage to your computer system.

For your own safety and for the protection of the system and the data stored in it, you should also make sure that the system is properly grounded. In addition, you should turn the system off immediately if there is a power brownout, electrical storm, or other power problem that might disrupt or damage your system.

Surge protectors are also a very good investment for your system, since household and office power supplies are often subject to spikes, surges, and other power transients. (Surge protectors and other protection devices are described fully in Chapter 2.)

Do not operate your system if it gets wet, or if you are in a wet environment. A short could seriously damage your system and even injure you if your system is improperly grounded.

Measuring Voltage and Logic

You have to be careful when you conduct tests of your system with the power on. Make sure that you set up your tests and have everything ready to go *before* you turn the power on. That way, you won't get confused and slip up. It's even a good idea to touch the test points before you turn the power on to make sure there are no equipment problems that have produced an undetected hot wire. Other good rules when working with the power on are:

1. Use only one hand.
2. Avoid contact with any metal surfaces.

Be careful to avoid short circuits by being absolutely sure that you are touching the correct test points and grounds and that no bits of metal or other foreign objects get into unwanted areas.

If you are not experienced or don't feel comfortable working around electricity, then *don't do it.* If you have doubts, it's much more economical and wiser to let a professional repair person handle this end of the troubleshooting process.

As I mentioned earlier, most troubleshooting and repair does not involve voltage and other power-on testing. If you want to conduct some tests but don't feel confident, let your repair person make the tests and arrive at a diagnosis.

Tools

Most of the troubleshooting and repair procedures described in this book can be accomplished with everyday household tools. For more complicated repairs, special tools are required; however, none of them are particularly expensive or difficult to use.

Screwdrivers To work on your computer, you will need a set of screwdrivers, including Phillips-head screwdrivers. For most repairs, normal-sized screwdrivers will do the job. However, in some cases, you may need small or extra-small-sized screwdrivers. Hex-nut drivers are also essential items.

Wrenches For some systems, you may need special wrenches, such as Allen wrenches. These wrenches are often supplied with the equipment. If not, they are readily available at hardware or electronics stores.

Tweezers Long tweezers can be useful in removing loose parts or foreign objects from small spaces.

Pliers A set of light needlenose pliers suitable for electronics work is also useful.

Wire Strippers Although this book does not contain many instructions on rewiring, a pair of wire cutters or wire strippers is a handy tool to have for any electronics work.

Gas Duster For cleaning, pressurized gas dusters are essential. You can purchase them in most computer, electronics, or photo supply stores.

Cleaning Liquids A number of cleaning solutions, including alcohol, electronic contact cleaner, and fast-drying solvents (such as Instant Out) are necessary. The proper use of these solutions is described in various parts of the book.

Volt-ohmmeter You need this meter, which can be either the traditional or digital type, to measure voltage, resistance, current, and continuity. You can purchase these meters for as little as $10.

Logic Probe This device determines if digital signals are flowing through a circuit. Most models have three readings, "high," "low," and "pulse," and cost about $20.

IC Remover Use this inexpensive tool whenever you insert or remove integrated circuits (ICs or "chips"). Chips are very delicate and require careful handling.

Diagnostics

Diagnostics are software programs that test the various hardware functions of your computer system, including the disk drive, the system CPU, and the memory. Although some personal computer manufacturers either provide diagnostic programs with their systems or sell them separately, Commodore does not yet market such programs.

It should not be surprising that Commodore, like other manufacturers, is not particularly helpful when it comes to self-maintenance and repair. Most large computer manufacturers have established an extensive service network to provide customer support for their products and they want their customers to use their own service network.

In addition, Commodore and other manufacturers have not yet recognized an emerging trend: Personal computer owners are taking on some aspects of maintenance and troubleshooting. However, as repair costs rise and more problems appear with aging personal computers, Commodore will undoubtedly respond to this trend by producing diagnostic programs for computer owners.

Meanwhile, a number of independent software companies produce diagnostic packages for personal computers. Although few are designed to operate on the Commodore 64 system, there will undoubtedly be more in the future. A list of diagnostic programs currently available appears in Appendix B.

These diagnostic programs can analyze various elements of a personal computer system, including CPU, memory, disk drive, keyboard, and peripherals. The most comprehensive diagnostic diskettes seem to be those for disk drive analysis. These diskettes can check drive speed, alignment, read/write ability, and other disk drive functions.

Unfortunately, many of these diagnostic programs do not go far enough in diagnosing failures. For example, they may indicate failure in the system's RAM but fail to specify the chip location. Nevertheless, the diagnostic programs can be a big help, especially if you want to do more complicated repair, such as disk drive adjustments or chip replacement.

Diagnostics diskettes cost from $30 to $100 and up, depending on the sophistication of the software. However, prices may come down as diagnostic software becomes more popular and more available to consumers.

If you can find a diagnostic program for your Commodore 64, it is a worthwhile investment. Such software lets you take diagnostic shortcuts to pinpoint the problem. Even if you aren't able to repair the problem yourself, you can at least save money by giving the professional repair person an accurate diagnosis.

Replacement Parts

Many replacement parts, including chips, are available from either Commodore itself or other manufacturers, including GE, Motorola, RCA, Phillips, Zenith and New-Tone. However, a number of Commodore's chips (integrated circuits) are proprietary and available only to Commodore's authorized dealers.

Despite the limited availability of these proprietary chips, you may be able to obtain suitable substitution chips for the Commodore 64 main board and disk drive logic board. One way to do so is to develop a friendly relationship with your Commodore dealer or repair person. He or she is likely to have a stock of these chips on hand, either from Commodore itself or from used systems, and may be willing to help out a regular customer.

Another perfectly good way to obtain substitute chips is from other Commodore 64 systems. Most newspapers carry advertisements for used computers, including Commodore 64s. For the price of a used computer, you can have a full set of substitute chips as well as other replacement parts.

Finally, Commodore user groups are a good source of both information and substitute parts. Many Commodore hobbyists have several systems and plenty of spare parts, including chips. These user groups are useful not only in finding spare parts but also in getting advice on repair work.

Because of the importance of chip substitution in computer repair, and because of the various avenues for obtaining substitute chips, I have included chip substitution procedures in several places in the book. I have also included parts lists and descriptions with the manufacturer's part number to make identification easier.

Basic Steps

Even if you have diagnostics software or other diagnostic aids, you should take a few basic steps before you tackle more serious troubleshooting and repair. Although these steps may seem obvious, they will eliminate 90 percent of the problems in computer repair.

As I mentioned in Chapter 1, most computer problems are caused by "idiot operators," and we've all fallen into that category at one time or another. These basic steps, which I repeat in the troubleshooting and repair sections, will keep you from falling into the idiot operator syndrome.

I. Make sure the system is turned on.

It's hard to believe, but some people just forget to turn on the power and then decide the system is broken. Remember that peripherals, too, have on/off switches.

Even if a switch is turned on, the problem may be there: The switch may not be working correctly. As a precaution, try flicking the power switch on and off several times. If the component shows signs of life, then at least you know that you are getting power from the power source.

II. Make sure the system is plugged in.

Always check that power cords are plugged in, both to the system and to the wall outlet. This goes for peripherals as well. Also, check that the plug is intact. It may be damaged or bent. If so, straighten out the bent prongs and try again. If that doesn't work, replace the plug.

III. Is your wall outlet dead?

You can check this first by plugging any electrical fixture into the wall outlet. A dead wall outlet means either a faulty outlet or a failure in household power supply. After checking for a blown fuse or tripped circuit breaker, you may determine that the wall outlet is faulty.

You can test your household power supply yourself using a voltmeter. If you need to replace the wall outlet, you can also do that yourself, or call an electrician. In any case, an electrician's house call is considerably cheaper than an on-site computer repair call.

IV. Remove any extension cords or surge protectors.

If you have a surge protector or other line protection device, remove it and plug the system directly into the wall outlet. If the system is connected to an extension cord, remove the extension cord and plug the system directly into the wall outlet.

V. Check your fuse box or circuit breaker.

If your system isn't getting power, you may have blown a fuse or tripped the circuit breaker. In that case, replacing the fuse or resetting the circuit breaker will get you started again, at least for awhile. However, you should try to determine what caused the circuit to overload in the first place.

Were other appliances operating on the same line? If so, turn off the other appliances *before* you try to start the computer system, and don't turn them on again while the system is in operation. In addition, try to put your computer system on a dedicated line—one that has only the computer and nothing else on it. Refer to the section in Chapter 2 that discusses dedicated lines and other power supply problems.

VI. Check for transients in your power supply.

Spikes, surges, and other power supply transients can cause problems with various components of your system. You can easily check your household or office power supply yourself using a voltmeter, or you can have an electrician check it.

The best protection against transients is to invest in a line conditioning device. Power protection procedures are described in detail in Chapter 2.

VII. Check for environmental sources.

Anything from a electrical storm to static electricity can cause computer problems. Always check for an environmental source of your computer problems. Procedures for dealing with environmental problems are discussed in Chapter 2.

VIII. Keep your system clean.

A dirty system, particularly a dirty system board or disk drive, can cause bewildering problems. Keep the system clean and always check to see if dirt, dust, or some foreign object is the source of your problems.

5

Troubleshooting the Console and Keyboard

This chapter is a practical guide to troubleshooting and repair of common problems that may plague your Commodore console and keyboard (see Figures 5–1, 5–2, and 5–3). Most of the problems described in this chapter do not require access to the interior of the console for repair.

However, if a repair does entail opening the console, here are a few points to remember: First, you may void your warranty or service contract by opening the unit. Although Commodore is unlikely to make a fuss unless you wreak havoc in the system, you should at least be aware of the risk you are taking. Second, remember always to *turn off the power and unplug the system* before doing any repairs inside the console. This step is essential both for your safety and the protection of the system.

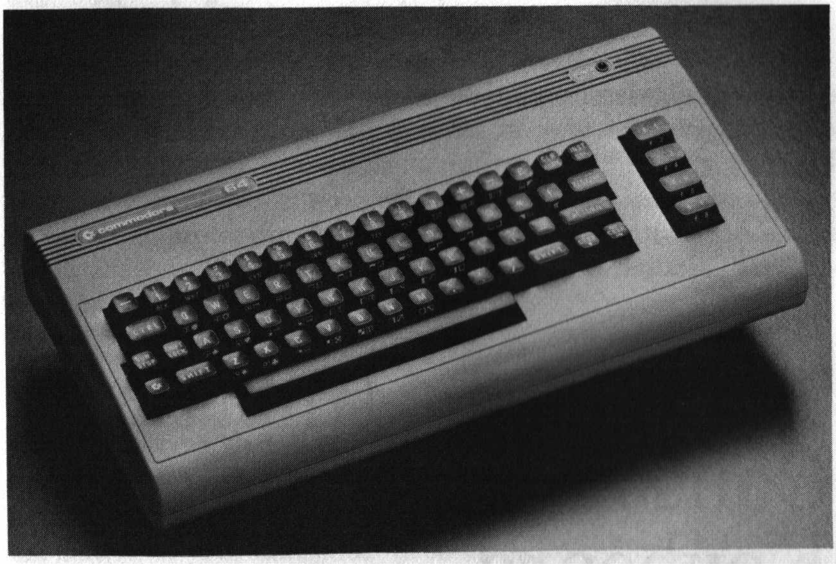


FIGURE 5–1 Commodore 64 Console: Top View

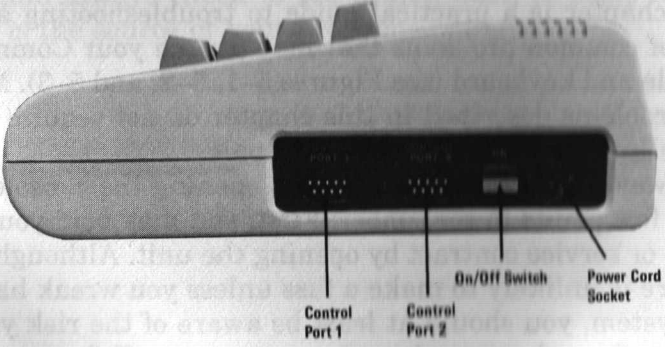

On/Off Switch
Power Cord Socket
Control Port 1
Control Port 2

FIGURE 5–2 Commodore 64 Console: Side View

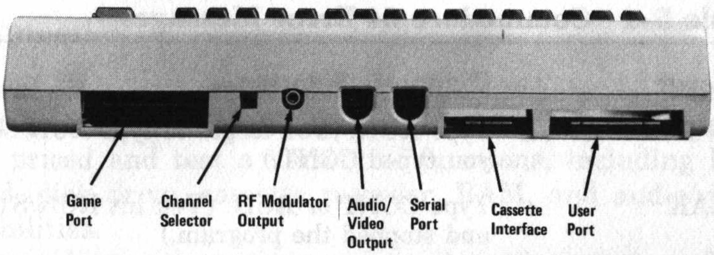


FIGURE 5–3 Commodore 64 Console: Rear View

Although this chapter covers the troubleshooting, diagnosis, and repair of the simplest problems affecting the console and keyboard, other, more serious problems require more complicated repair procedures. The most obvious source of help with these complicated problems is a professional repair person, either at your dealer, a third-party service center, or Commodore.

In some cases, you can repair complicated problems yourself, especially if repair simply entails cleaning the inside of the system or replacing a standard component. See the detailed procedures for these repairs later in this chapter; also see Chapter 3 for step-by-step cleaning procedures.

Basic Troubleshooting and Diagnosis

This section discusses common problems associated with the Commodore console. It gives basic troubleshooting and diagnostic procedures to correct the most obvious problems.

If these basic troubleshooting techniques don't solve your problem, then refer to the second part of the chapter, which

Table 5–1 Commodore 64 Error Messages

Message	Diagnosis/Solution
CAN'T CONTINUE	Type RUN. (You forgot to type RUN before you typed CONT.)
BREAK	Type CONT or RUN. (You hit RUN/STOP and stopped the program.)
FILE NOT FOUND	The computer can't find the file you're looking for, either on cassette or disk. This signals either file damage or a disk/cassette hardware problem.
FILE NOT OPEN	Error in opening or closing file.
FILE OPEN	Error in opening or closing file.
LOAD	Loading problem; try again. If no success, switch programs; if that doesn't work, there may be a cassette or disk problem.
OUT OF DATA	Not enough data to read.
BAD DATA	Data does not fit program.
OUT OF MEMORY	May indicate a memory problem.
VERIFY	Error on tape or disk; may indicate a disk drive or cassette hardware problem.

provides detailed, step-by-step troubleshooting and repair procedures.

Remember that the key to successful troubleshooting is proper identification and diagnosis of problems. If something goes wrong with your computer, observe the symptoms carefully and compare them to the common symptoms described below.

Error Messages

If your Commodore displays an error message, then you should first suspect a software error and try to correct it. Table 5–1 lists several common Commodore error messages and some software solutions.

Diagnostics

Several diagnostic programs on the market help you troubleshoot your Commodore 64 system. Most of them are reasonably priced and test a variety of functions, including keyboard, disk drive, cassette recorder, RAM, and audio/video capabilities.

These diagnostic programs are well worth the price, which is usually less than one visit to the repair shop. Some of the companies that sell diagnostic programs are listed in Appendix B.

If you have a diagnostics disk, test the system with the diagnostics first. However, you may have a power problem that prevents you from running the disks. In addition, the diagnostics may indicate a power or system problem without being specific. Nevertheless, you should always run these tests before you begin your own troubleshooting procedures.

I. There is no power.

Symptom Your system appears to be dead. It has no power whatsoever when you turn the power switch on. If your system functions smoothly for awhile and then mysteriously stops working, proceed to the next section.

Diagnosis Your computer is lying there like a dead fish for one of many possible reasons. The most probable reasons are problems with your household or office power supply, unplugged cords or power cables, overloaded circuits, or other power supply problems.

The best approach is to begin with the most simple treatment procedures and proceed by trial and error. Always remember to *turn the power off* when testing power plugs and other elements of the system. This is particularly important when troubleshooting for power problems.

Treatment

1. Try flicking the power switch on and off. Does your system show any signs of life? If so, at least you know that you are getting power from the power source.
2. Check the power plug. Is the power plug inserted firmly into the power socket on the side of the console? If not, make sure the system is turned off and insert the plug firmly into the power socket. Is the power cord plugged firmly into a wall socket? Also, check that the plug is intact. If it is damaged or bent, you may have to replace it.
3. If you have a surge protector or other line protection device, remove it and any extension cords, and plug the system directly into the wall outlet.
4. Is your wall outlet dead? Check by plugging some electrical fixture into the wall outlet. A dead wall outlet might mean either a faulty outlet or a failure in your household power supply. After checking for a blown fuse or tripped circuit breaker, you may determine that the wall outlet is faulty. In that case, you can either replace it yourself or call an electrician.
5. Check your fuse box or circuit breaker. If the wall outlet is dead, you may have blown a fuse or tripped the circuit breaker. In that case, replacing the fuse or resetting the circuit breaker will get you started again, at least for awhile. However, you should try to determine what caused the circuit to overload in the first place. Were other appliances operating on the same line? If so, turn off the other appliances *before* you try to start the computer system, and don't turn them on again while the system is in operation. In addition, try to put your computer system on a dedicated line—one that has

the computer and nothing else on it. See Chapter 2 for a discussion of dedicated lines and other power supply problems.

6. Check for surges, spikes, or other power transients. The computer is designed to shut off automatically if these power fluctuations occur. You can test your household power supply using your voltmeter.
7. If you can't find anything wrong with the household power supply, you now have to focus your attention on the system itself. Begin by unplugging all of the external devices, including the cassette recorder or disk drive, monitor, modem, printer, and so on. After you've unplugged everything but the console, try turning the system on again. If the system turns on, then you can assume you have a problem with one of the peripherals. Add each peripheral individually until the power shuts off, then turn to the chapter on troubleshooting that component. You should also try swapping cables as well.
8. Remove the console cabinet and check to see if the fuse, which is located on the right side of the main board, is blown. If so, replace it. The fuse is a 1 ampere, 250 volt fuse, size 3A. (The manufacturer's part number is 903556-18.)
9. Check the power supply to your console. For this, you need a voltmeter to test the voltage. For a description of this procedure, see the repair section of this chapter. If the voltages are not correct, then you may have to replace the console power supply.
10. If the voltages to the console are correct, then you should check the voltage flowing to the disk drive to determine if the console power supply is failing. See the repair section in this chapter for that procedure. If voltage readings are not correct, then you may have to replace the power supply unit.

11. If your system passes all the tests up to this point, including correct voltage readings, then you have to consider problems with the system board itself. Test the resistance of the system board according to the procedures outlined in the repair section of this chapter. If the readings are high, then you should replace the power supply. If they are low, then you should look for problems in the system board itself.

II. The system operates for a while, then dies.

Symptom The system operates smoothly for a while, then suddenly loses power.

Diagnosis There are two likely explanations for this intermittent operation. The first culprit is your household or office power source, which may be feeding your system dirty power. This, in turn, can shut your computer system down. The second possibility is a malfunction inside the console itself, including the power supply or the system board.

Treatment

1. Turn the system off for a while, then start it again. If it operates smoothly with no further problem, then you may have encountered a fluke power problem, which may never return again. (Knock on wood!) However, if the problem returns a day or even a week later, then you should consider checking your household power supply and also investing in a surge protector. (See Chapter 2 on household power supply problems and power supply protection devices.)
2. If your system runs for a while and then shuts off again, you may have a chronic household power supply problem. In that case, check your household

power supply for voltage problems and/or invest in a surge protector.

3. If you are pretty sure that your household power supply is clean, then try disconnecting all external units in your system, such as the printer, disk drive, or cassette, then turn the system on again.
4. If this doesn't solve the problem, then you may have loose or dirty contacts inside the console or failing components. Your system may simply need a good cleaning, or it may have more serious problems. See Chapter 3 for step-by-step procedures.
5. If cleaning the console doesn't solve the problem, then proceed to the step-by-step procedures later in this chapter for diagnosis and repair of power supply and system board problems.

III. The system stops but still has power.

Symptom The system operates smoothly for a while, then stops working for no apparent reason. Before you try to diagnose the problem, you should observe carefully what is happening.

1. Does the system stop working randomly, for no apparent reason, or does it crash when you attempt either a software or hardware operation (such as turning on a printer or another component)? If it does not happen randomly, then proceed to section IV, which describes system crashes that occur when you attempt a specific operation.
2. Does the system have any power at all? If the system is working fine and suddenly goes dead, the first thing to check is the power supply to the system. Review sections I and II, above, which describe treatment of various power supply problems.

Diagnosis There are at least three general explanations for the mysterious shutdown of your system. The first possibility is a power problem, most likely surges or spikes, which can cause your system to overload and then shut down as a protection against damage. Another possibility is that the software is jamming the system. Finally, you may have a serious system problem, including one or more faulty chips or components.

Treatment

1. Turn the computer off for a little while, then turn it back on again. If it functions without further problem, you may have had a surge or a spike that caused the internal safeguards to shut the system down. If the computer returns to smooth operation without further incident, you have very little to worry about. However, if you continue to have these shutdowns, you may have a chronic power supply problem. In that case, it's a good idea to check your household power supply for transients, noise, and other garbage on the line. If you're already pretty sure that your power supply is a problem, you can save money by buying a surge protector.
2. Another possibility to consider is static electricity. If you suspect the cause of your problems is static electricity, then it is wise to invest in antistatic rugs, or, at least, antistatic spray. (See Chapter 2 for a discussion of problems caused by static electricity and other environmental problems.)
3. Remove the software tapes or diskettes you are using, turn the system off, and then carefully replace the tapes or diskettes. If the problem is solved, then it was probably caused by a household power supply. If it is not solved, try using another software tape or diskette. If this measure solves the problem, something is probably wrong with the original tape or diskette, and you should replace it. If the other soft-

ware doesn't work, then you have to suspect problems with the hardware and should proceed to the step-by-step troubleshooting and repair procedures later in this chapter.

IV. The system operates but crashes when you attempt an operation or turn on a peripheral.

Symptom Your system works fine until you try a specific operation, either involving software or hardware. If your system crashes randomly, or simply shuts down with no power at all, then check sections II and III, above.

Diagnosis There are three likely reasons why your system stopped running smoothly. The most probable is a software problem, usually with the program, but also possibly with the tape or diskette. Another possibility is a problem with a peripheral or component of the system. You should suspect the latter if the computer stops running, for example, when you turn on your printer. A final possibility is the household power supply, although this is less likely since shutdown occurs when you attempt a specific operation on the system.

Treatment

1. If you suspect the software, try turning the system off and removing the software tape or diskette. Turn the system back on, reinsert the same tape or diskette, and try the same operation again. If the system shuts down again, try the same procedure, this time using another software program. If this solves the problem, replace the original tape or diskette.
2. If the software checks out, and your problem occurs when you turn on a peripheral, such as a printer, try turning off the peripheral and running the system. If

you have no further problem, you should check the printer or other peripheral for problems.

3. If neither the software nor the peripherals seem to be the problem, check for household power supply problems and for an environmental source, such as static electricity. Also check for loose or defective plugs, cables, or power cords.
4. If none of the above procedures solve the problem, then you have to suspect more serious trouble, possibly inside the console. You may want to clean the inside of the console first (see Chapter 3 for step-by-step procedures) and then proceed to the step-by-step troubleshooting and repair procedures later in this chapter.

V. The system operates smoothly, then begins to behave erratically.

Symptoms In this case, the system operates well, except for occasional, irrational, and intermittent errors. These errors can take a number of forms and show up either on the monitor or during printing. The problem with these errors is that they often have no rhyme or reason and are therefore hard to diagnose and solve.

Diagnosis Although the most likely culprit is software, these intermittent errors can also be caused by failing RAM modules, loose connections, or even local power supply problems.

Treatment

1. Check your software. Remove the tape or diskette, reinsert it, and try it again. If you still get random errors, remove the tape or diskette and replace it with another software program. If you still have a

problem, then you can assume it is not software related.

2. Check for household power supply or environmental sources. Power transients, static electricity, or brownouts could be causing the problem.
3. You may have memory problems. If so, try to pinpoint the location of the failing chip and replace it. For this procedure, see the step-by-step troubleshooting and repair procedures later in this chapter.

VI. There is garbage on the screen.

Symptom At some point during operation, either when you turn the system on or after it's been on a while, the video display begins filling with "garbage"—random numbers and characters.

Diagnosis The most likely diagnosis for this phenomenon is a power supply problem or, more seriously, a failing memory or central processing unit. Other possibilities include a software or peripheral problem.

Treatment

1. Check for household power supply or environmental problems.
2. If there are no problems, then try swapping software tape or disks and disconnecting peripherals. If that doesn't solve the problem, then proceed to the troubleshooting section to check the system's memory.

VII. The computer is overheating.

Symptoms The computer begins to behave erratically or even shuts down. The console box is hot to the touch.

Diagnosis The most likely cause is a blocked ventilation outlet, or a problem with the cooling system.

Treatment

1. Check the room temperature. It may simply be too hot for the computer to operate effectively. If so, you should be very uncomfortable yourself; in that case, you should probably turn the computer off and go someplace cool. However, your computer may also be overheating because it is in direct sunlight. If so, turn the system off and move it immediately to a spot away from direct sunlight. (Also refer to Chapter 2 for other suggestions on proper care for your computer.)
2. Check to see if the ventilation outlets are blocked. You can inadvertently block the outlet simply by putting a sheet of paper or a book over it. Dust or other foreign matter can also block outlets, in which case you should remove the console cabinet and clean the outlet.

Step-by-Step Troubleshooting and Repair Procedures

The following section contains detailed, step-by-step troubleshooting and repair procedures for your console, including your system power supply and main system board.

Since many of these procedures involve working with the power on, be sure to follow the safety precautions outlined in Chapter 4. These are particularly important during power supply and other console procedures, when carelessness could result in damage to the system and injury to yourself.

If you do not feel competent or confident in making these repairs, or if you get stuck, refer the problem to a professional repair person. It's much better to err on the side of caution and prevent costly damage to the system.

The first part of this section covers troubleshooting and repair of power supply problems, while the second part covers troubleshooting and repair of system board problems. Note that Commodore produces two versions of the C64 main system board: revision A and revision B. Since the two versions are similar, this book uses the later revision B main board as the standard. (However, a chip map for the revision A board is shown in Figure 5–7.)

Power Supply Problems

Before you begin these procedures, be sure to take some of the simple steps described earlier in this chapter. They include:

1. Make sure that the system is turned on, that all the plugs are inserted correctly, and that the cables are not defective.
2. Check your household power supply to make sure the voltage levels are steady. Also check for environmental sources of the problem, including static electricity, electrical storms, and so on.
3. Disconnect all external components, including the printer and modem. If this solves the problem, then reconnect each component one at a time to find the faulty component.

If none of these procedures solve the problem, then begin with the step-by-step troubleshooting procedures below:

Checking the Power Supply The following procedures require using a voltmeter for testing. If you don't feel competent to use a voltmeter or to check test points, take your system in for professional testing and repair. Even if you do feel competent to do the job, it is a good idea to refer to an electronics or computer technical repair manual to refresh your memory about digital electronics and testing techniques. Although it is useful to check for proper functioning of all the components described below, it is wiser to leave replacement of certain components, particularly diodes and capacitors, to professional service technicians.

1. With the console cabinet removed (see procedure below), disconnect the power connector CN7 (see Figure 5–4) from the power input on the computer.
2. With the power supply plugged into 120V ac, use your voltmeter to check for 10.90V ac across pins 6 and 7 of CN7.
3. Also check for 5.08V across pins 2 and 4 on CN7 (see Figure 5–4). If you don't get these voltage readings, then you should replace the power supply.
4. If the readings are correct, then reconnect the power connector and check for a reading of 11.77V at the anode of diode CR6 (see Figure 5–4).
5. If the reading is incorrect, then check the fuse. If it is bad, replace it. But first, check for shorts at the bridge rectifier CR4 (see Figure 5–4), capacitors C19 and C95 (see Figure 5–5), and voltage regulator VR2 (see Figure 5–4).
6. If the fuse is OK, then check the voltage across capacitor C21 (Figure 5–5), which should be 10V ac. Also check coil L4 (Figure 5–4) by testing voltage at pins 6 and 7 of the power input, CN7. If the readings are incorrect, then you should replace the power supply.
7. Check pin 2 of the voltage regulator VR1 (Figure 5–4) for 11.76V. If the readings are wrong, then check for shorts in VR1 and diode CR5 (Figure 5–4) and shorts in capacitors C88, C89, and C90 (Figure

5–5). If these are OK, then you should replace the power supply.

8. Check for 4.91V at the positive end of capacitor C91 (Figure 5–5). If the reading is incorrect, then check coil L5 (Figure 5–4) for an open circuit.
9. If coil L5 is OK, then check the power switch SW1 (Figure 5–4). If the switch seems defective, turn the power off and check that no wires to the switch are loose or defective. If there is still a problem, replace the switch.
10. Check at pin 5 of the power input CN7 (Figure 5–4) for 5V. If the readings are incorrect, also check the connectors. If the readings are still wrong, replace the power supply.
11. Check for 4.93V at pin 2 of voltage regulator VR2 (Figure 5–4). If the reading is incorrect, check VR2 and capacitors C65, C66, C102, and C103 (Figure 5–5).
12. Check capacitors C56, C67, C68, C74, C82, and C84 (Figure 5–5) for 4.88V.

Checking the Main Board Power

1. If the LED power indicator does not light, then check for a blown fuse F1 and check the power switch SW1 (Figure 5–4).
2. Check the bridge rectifier CR4 for 11.77V.
3. Check the voltage regulator VR2 at pin 2 for 4.93V.
4. Check at coil L2 for 4.93V.
5. Check at coil L5 for 4.91V.
6. Check for 11.76V at pin 2 of voltage regulator VR1.
7. If all readings are correct, then check functions on the main board.

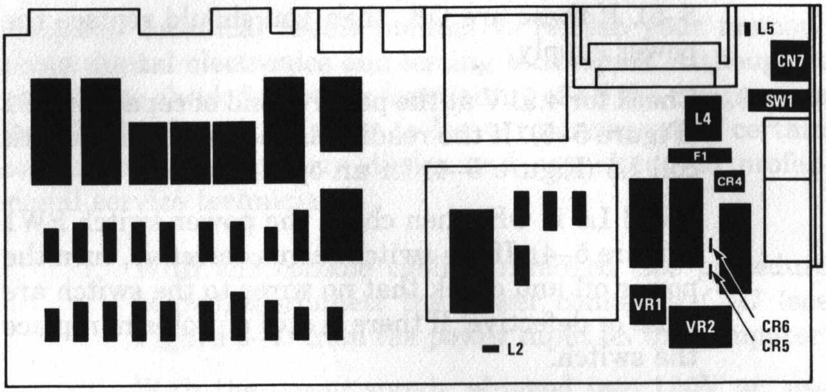

L5
CN7
SW1
L4
F1
CR4
VR1
VR2
CR6
CR5
L2

FIGURE 5–4 Commodore 64 Main Board (Rev. B): Power Test Points

Removing the Power Supply Unit

1. Making sure the power is *off* and all power cords are unplugged, disconnect the power connector CN7 (Figure 5–4) from the computer.

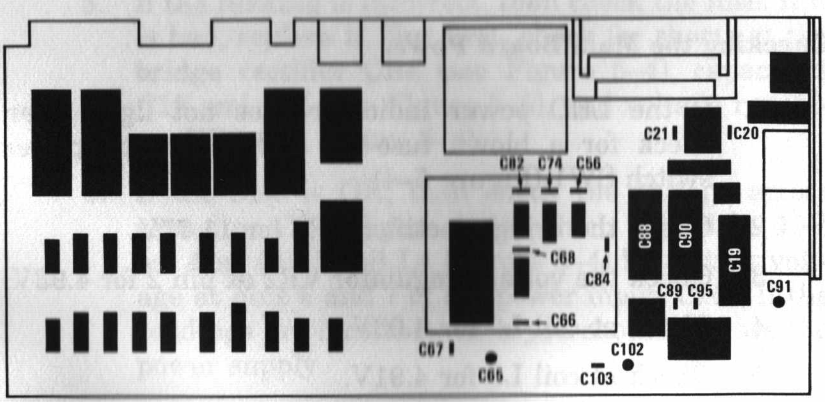

C21
C20
C82
C74
C56
C68
C84
C88
C90
C19
C89
C95
C91
C66
C67
C65
C102
C103

FIGURE 5–5 Commodore 64 Main Board (Rev. B): Capacitor Locations

2. When removing the connectors, be sure to hold the connector itself (not the wires) and to pull it firmly straight up.

Replacing the Power Supply Unit

1. Purchase the Commodore 64 power supply, manufacturer's part number 251053-02.
2. Place the power supply in position.
3. Gently replace the power input connector.

System Board Problems

If the diagnostics diskette or your tests so far indicate a problem with the system board or memory, or if the symptoms described earlier in this chapter point to a system board problem, then proceed with the step-by-step troubleshooting techniques in this section.

If you are unsure about your diagnosis or you are not confident about troubleshooting and repairing the console yourself, then take the system or just the board to a professional repair person. If you think you might risk damaging the system, it is much wiser and less expensive in the long run to take the console to a repair shop and have a professional take a look at it.

Before proceeding to the step-by-step troubleshooting and repair procedures in this section, make the following simple checks:

1. Make sure that all plugs and connectors are properly inserted and that the system is turned on.
2. Make sure there are no household power supply problems or other environmental problems.
3. Make sure that the system board is clean and free of foreign objects that might be causing problems.

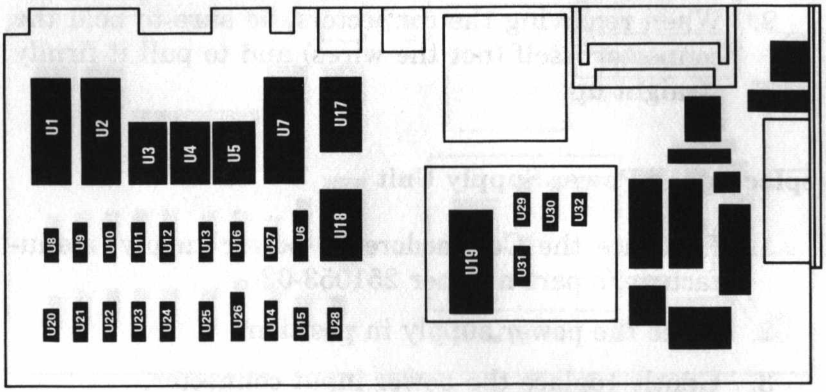


FIGURE 5–6 Commodore 64 Main Board (Rev. B): Chip Map

4. Check that all the system board switch settings are correct. For these settings, refer to your Commodore manual.

Checking Main Board Function You need a logic probe for these tests. If you are not familiar with operation of a logic probe, consider taking the system to a professional repair person. Even if you are familiar with logic probe operation, it is a good idea to refresh your memory by reading a technical manual on digital electronics or computer repair.

1. Using a logic probe, check for pulses on pins 7 through 20, 22 and 23, and 30 through 37 on the microprocessor IC U7. (See Figure 5–6 if your system has a revision B main board. If your system has the revision A board, extrapolate these instructions to the chip map shown in Figure 5–7.) If these readings are not present, then check pin 40 of IC U7 with a logic probe while turning the computer off and back on. The probe should read low for

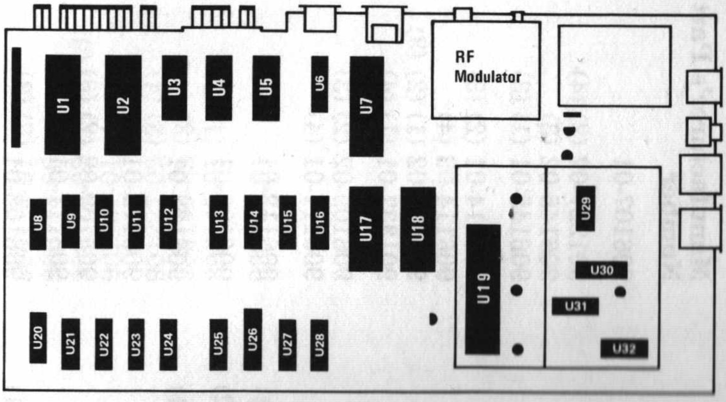

RF
Modulator
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
U16
U17
U18
U19
U20
U21
U22
U23
U24
U25
U26
U27
U28
U29
U30
U31
U32

FIGURE 5–7 Commodore 64 Main Board (Rev. A): Chip Map

about two seconds after you turn the power on, then return to high.

2. If the readings are not correct, check the timer integrated circuit (IC) located at U20 by substitution. If the timer IC is working, then check pin 3 of IC U7 for pulses and check pin 4 of IC U7 for a high reading. If the pin 3 reading is not correct, substitute complex interface adapter U1. If the pin 4 reading is not correct, substitute complex interface adapter IC U2.
3. If microprocessor readings are correct, then you may have to check by substituting Kernal ROM IC U4, program logic array IC U17, and video interface IC U19.
4. If the problem is no audio, then substitute the sound interface device IC U18.
5. If the disk drive or printer is not operating properly, substitute complex interface adapter IC U2.

Table 5–2 Main Board Chip (IC) Substitution Chart

Problem	Substitution	Manufacturer's Part Number
No computer function	Microprocessor IC (U7)	906107-01
No computer function	Kernal ROM IC (U4)	901227-02 (2) (4) 906145-02 (3) 906145-01 (1) (3)
No computer function	Program Logic Array IC (U17)	906114-01 (2) (3) 906114-06 (4) 906114-02 (1) (2) (3) 901337-01 (1) (4)
No computer function	Video Interface IC (U19)	906109-02 (2) (3) 906111-01 (4)
No sound	Sound Interface Device IC (U18)	906112-01
Disk drive or printer	Complex Interface Adapter IC (U2)	906108-01
Cassette	Complex Interface Adapter IC (U1)	906108-01
Audio/video port	Sound Interface Device IC (U18)	906112-01
Audio/video port	Video Interface IC (U19)	906109-02 (2) (3) 906111-01 (4)
Keyboard	Complex Interface Adapter IC (U1) Keyboard Decoder IC	906108-01 901521-18

Modem	Complex Interface Adapter IC (U1)	906108-01
	Complex Interface Adapter IC (U2)	906108-01
Cartridge port	Program Logic Array IC (U17)	906114-01 (2) (3) 906114-06 (4) 906114-02 (1) (2) (3) 901337-01 (1) (4)
	Kernal ROM IC (U4)	901227-02 (2) (4) 906145-02 (3) 906145-01 (1) (3)
Control port	Complex Interface Adapter IC (U1)	906108-01

6. If the Datassette is not functioning, substitute complex interface adapter IC U1.
7. If the audio video port is not working, substitute the sound interface device IC U18 and the video interface IC U19.
8. If the keyboard doesn't work, substitute the complex interface adapter IC U1, and the decoder IC U15.
9. If the modem doesn't work, substitute complex interface adapter ICs U1 and U2.
10. If the cartridge port doesn't work, substitute program logic array IC U17 and Kernal ROM IC U4.
11. If the control port doesn't work, substitute the complex interface adapter IC U1.

Procedure for Replacing Chips

1. Obtain a substitute chip. See Chapter 4 for ways to find substitute chips for the Commodore 64. Make sure, however, that the replacement chip is a duplicate of the faulty chip.
2. Using an IC remover (a tweezer-like tool available at Radio Shack and other electronics outlets), remove the chip *gently* from its socket. (If the chip is soldered in place, then have a professional replace it, unless you feel confident of your soldering technique and have experience in soldering electronic components. Even so, you should consult a professional repair manual for special soldering procedures.)
3. Dust the empty socket with a pressurized gas duster, then spray it with electronic contact cleaner.
4. Using an IC remover (or *clean* fingers), gently insert the chip into the socket, beginning with one row of

pins, then inserting the other row. Then gently press the chip down into the socket.

Removing the Console Cabinet

1. Turn off the power. Unplug and disconnect all cables to the unit.
2. Remove the three screws from the bottom of the cabinet. Gently lift the cabinet top and the keyboard from the bottom of the cabinet.
3. Disconnect the keyboard connector (left side of the unit) and the power indicator connector (upper right side of the unit) from the system board.
4. Remove the cabinet top and keyboard.

Replacing the Main Board If you decide to replace the main system board, you should be careful not to damage the new board through sloppy handling.

1. To remove the board, unsolder the copper strip on the top right side of the cardboard shield and then carefully fold the shield back.
2. Remove the seven screws holding the main board to the bottom of the cabinet.
3. Unsolder the grounding strip at all nine places on the main board.
4. Remove the shield and main board from the bottom of the cabinet.
5. To replace, gently place the new board in the cabinet bottom.
6. Resolder the grounding strip to the nine points on the main board.

7. Replace the seven screws on the bottom of the cabinet.
8. Resolder the copper strip on the shield.

Console Troubleshooting Chart

I. There is no power.

Diagnosis	**Treatment**
Defective or loose switches, cords, or plugs	Check that all switches are on, plugs are inserted, and cords are intact.
Household power supply problem	Check household voltage; if problems, install surge protector.
Console power supply problem	Check voltage readings on system, replace power supply.
System board problem	Check and replace parts or entire board.

II. The system operates for a while, then dies.

Diagnosis	**Treatment**
Defective or loose switches, cords, or plugs	Check that all switches are on, plugs are inserted, and cords are intact.
Household power supply problem	Check household voltage; if problems, install surge protector.
Console power supply problem	Check voltage readings on system, replace power supply.
System board problem	Check and replace parts or entire board.

III. The system stops but still has power.

Diagnosis	**Treatment**
Environmental source	Check for static electricity.
Software problem	Check for damaged disks or software bugs (swap software).

Household power supply problem	Check household voltage; if problems, install surge protector.
Console power supply problem	Check voltage readings on system, replace power supply.
System board problem	Check and replace parts or entire board.

IV. The system operates but crashes when you attempt an operation or turn on a peripheral.

Diagnosis	Treatment
Software bug	Check for software bugs (swap software).
Peripheral problem	Disconnect peripheral and test system.
Household power supply problem	Check household voltage; if problems, install surge protector.
Console power supply problem	Check voltage readings on system, replace power supply.
System board problem	Check and replace parts or entire board.

V. The system operates smoothly, then begins to behave erratically.

Diagnosis	Treatment
Software bugs	Check software.
Environmental source	Check for static electricity.
Household power supply problem	Check household voltage; if problems, install surge protector.
Peripheral problem	Remove and test system.

VI. There is garbage on the screen.

Diagnosis	Treatment
Household power supply problem	Check household voltage; if problems, install surge protector.

VI. *(Continued)*

Diagnosis	Treatment
Console power supply problem	Check voltage readings on system, replace power supply.
Peripheral problem	Remove and test system.

VII. The computer is overheating.

Diagnosis	Treatment
Blocked ventilation outlet	Check for foreign object, dust, etc.

Troubleshooting Your Keyboard

The keyboard is one of the most vulnerable parts of the computer system, largely because of its extensive contact with the computer operator. If the computer operator happens to deserve the disparaging label IO (idiot operator) applied by some service people, then the keyboard is in particular jeopardy.

Even those of us who don't consider ourselves idiot operators need to take proper care of the keyboard, since its health is particularly important to the smooth operation of the computer system. Chapter 2 outlines some of the most important precautions you can take to protect your keyboard, including protecting it with a dust cover when you're not using it, cleaning it at least twice a year, and preventing spilled drinks and other accidents that can ruin a keyboard.

Common Problems

Most Commodore keyboard problems are the result of dirty contacts. The contacts are simply strips of metal. When you press a key, it touches the contact, thus completing a circuit and sending a signal to the computer. These keyboard contact points, located under the keys, are particularly vulnerable to dust and other foreign material, not to mention spilled drinks or similar disasters.

Chapter 3 sets forth procedures for cleaning and maintaining your keyboard, and it is a good idea to look at that chapter if you are having keyboard problems. However, this section also gives a step-by-step guide to cleaning your keyboard when a problem arises.

I. Nothing happens when you press a specific key.

Symptom One particular key produces nothing on the screen, and the other keys seem to work fine.

Diagnosis The most likely cause is a dirty contact on the malfunctioning key, although a failing chip may also be to blame.

Treatment

1. Clean the key contacts as described in the sidebar.
2. If cleaning the key contacts doesn't solve the problem, it is possible, though less likely, that a chip, either in the keyboard or in the console, is failing (see Table 5–2 for chip replacement).

II. When you press a particular key, two characters appear on the screen instead of one.

Symptom You press a particular key, for example R. Instead of a single R, two Rs appear on the screen.

Diagnosis This problem is probably due to dirty contacts, although it may also be caused by a failing chip in the console.

Treatment

1. Clean the keyboard as described in the sidebar.
2. If cleaning the keys doesn't solve the problem, a failing chip may be at fault (see Table 5–2). In that case, try swapping your keyboard or simply take the console in for repair.

III. The keyboard produces junk on the screen.

Symptom The keyboard seems to be working, but the letters do not appear as you type them. Instead, junk—random characters—appears on the screen.

Diagnosis This condition is probably not caused by dirty keyboard contacts unless you recently spilled liquid onto the keyboard or had a similar accident. (If you do have such an accident, consult Chapter 3.) A more likely culprit is either a stuck function key or a failing chip (see Table 5–2).

Treatment

1. Check that none of the keys, especially the function keys, are stuck, since a stuck key can cause this symptom. If one of the keys is stuck, and continues to stick, then clean the keyboard.
2. If nothing appears to be wrong with the keys, then your problem is probably a failing chip; you should try substituting chips indicated in Table 5–2 or take the console in for professional repair.

IV. The keyboard suddenly locks.

Symptom The keyboard suddenly stops functioning after working well. Pressing keys produces no results.

Diagnosis This is most likely not a keyboard problem but a system problem, caused by either power supply or environmental difficulties. For example, a large jolt of static electricity can cause your system to crash, as can a sudden surge of power or an electrical storm. This can also be a result of a software bug that "freezes" your system.

Treatment

1. Consult Chapter 2 on power supply and environmental problems that can cause your system to crash. If, after checking for local power supply and environmental sources, you still cannot locate the problem, then proceed to the next step.
2. Check to make sure none of the function keys are stuck. Also check the keyboard contacts to make sure they are clean. If not, clean them.
3. If your keyboard still won't work, a defective chip or other problem may be to blame. Take the console in for repair, or substitute chips (Table 5–2).

V. You have just spilled water, beer, or other liquid on the keyboard.

Symptom The symptom is obvious. Liquid, even water, is very bad for the keyboard and console. It literally gums up the works and can cause corrosion even after it's been cleaned up.

Diagnosis The diagnosis is possible disaster for the keyboard, although you can take a few steps to salvage it.

Treatment See the section "Spilled Liquids" in Chapter 3.

Sidebar: Removing and Cleaning the Keyboard

Many problems with the keyboard are due to an accumulation of dust or dirt. The first step, before you remove the keyboard from the console, is to clean the top of the keyboard with a gas duster. If that doesn't solve your keyboard problems, proceed with the removal and cleaning procedures below.

1. Remove the three screws from the bottom of the console cabinet.
2. Lift the cabinet top and disconnect the keyboard connector and power indicator connector from the main board.
3. Remove the eight screws that attach the keyboard to the cabinet top and lift the keyboard assembly.
4. Begin by thoroughly dusting the keyboard assembly with a gas duster.
5. Examine each key switch to make sure that no foreign object, dirt, or dust is interfering with good contact. Then carefully clean each key contact with an electronic contact cleaner.
6. Replace the keyboard assembly and console.

Keyboard Troubleshooting Chart

I. Nothing happens when you press a particular key.

Diagnosis	**Treatment**
Dirty key contact	Clean keyboard.
Chip failure	Substitute chips or get professional repair.

II. When you press a particular key, two characters appear instead of one.

Diagnosis	Treatment
Dirty key contact	Clean keyboard.
Chip failure	Substitute chips or get professional repair.

III. The keyboard produces junk on the screen.

Diagnosis	Treatment
Stuck key	Remove and clean.
Bad cable	Check cable.
Chip failure	Substitute chips or get professional repair.

IV. The keyboard suddenly locks.

Diagnosis	Treatment
Bad cable	Check cable.
Stuck function key	Remove and clean.
Software bugs	Check software.
Environmental source	Check for static electricity.
Household power supply problem	Check household voltage; if problems, install surge protector.
Chip failure	Substitute chips or get professional repair.

6

Troubleshooting the Video Monitor

This chapter is a troubleshooting and repair guide to your video monitor. The step-by-step procedures for video monitors apply to both Commodore monitors and most non-Commodore monitors. They also apply to television sets used as monitors.

Probably the most important advice on trouble-free operation of video monitors is found in Chapter 2, which discusses proper care of your computer system. Dust, dirt, spilled drinks, and foreign objects are the main enemies of all elements of your computer system, including the monitor.

A dust cover is a good idea, since dust can wreak havoc on the monitor. The video monitor, like a television set, attracts dust and is therefore particularly vulnerable to dust-associated problems.

A word of caution on video monitors. Like a television set, the display section of a video monitor, depending on whether it is black-and-white or color, can have extremely high voltage levels. *Never* work on the interior of a video monitor when the power is on.

This troubleshooting guide does not tell how to make repairs inside the monitor. (If you are ambitious, you might buy a book on television servicing and give it a try. Otherwise, take the monitor to your dealer or to a television repair shop for service.) Since video monitors and television sets are generally reliable, there should be no reason to open the monitor for repairs. You can correct or at least diagnose most of the problems without opening the box.

Description of Video Monitor

Several kinds of video display monitors can be used with the Commodore 64. They can either be models made by Commodore (see Figure 6–1) or by other manufacturers. And they range from simple home television sets to sophisticated color monitors.

The Commodore 64 can also be adapted to operate with an ordinary television set, but special modulator equipment is required. However, home television sets have lower resolution than monitors designed specifically for a computer system.

Troubleshooting Your Video Monitor

Video monitors, which use current solid-state technology, should not present many serious problems. If a serious problem does arise, you should probably seek the help of a professional television or computer service person. If you are particularly skilled in television repair and want to take a crack

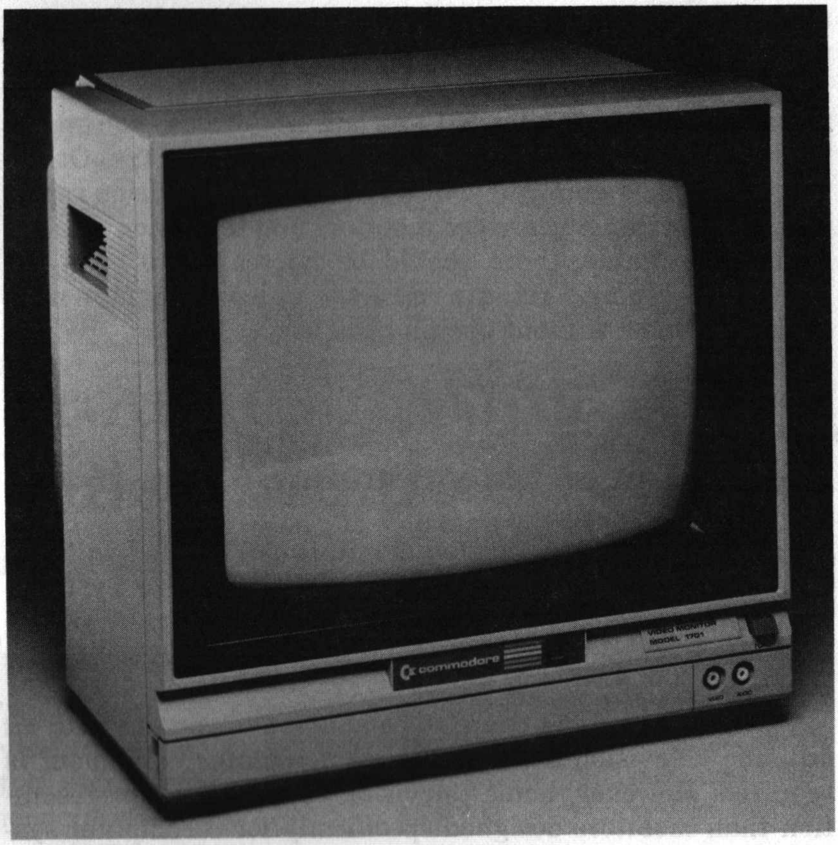


FIGURE 6–1 Commodore Monitor

at it yourself, consult one of several good television repair manuals available on the market.

This book details only the common problems that affect video monitors and their solutions. None of these solutions entail working on the interior of the monitor or actually repairing it. This kind of repair is beyond the skill of the ordinary computer user and can be very dangerous because monitors operate on high voltage. Because of the relatively low cost of television repair (compared with the cost of computer repair, anyway), get help from a professional when your monitor develops serious bugs.

Common Problems

The following section outlines some common monitor problems and gives a step-by-step guide to repairing them. These repair procedures assume that you have a Commodore-manufactured video display unless otherwise noted. However, most standard computer video monitors have comparable configurations, and you should have no problem adapting these step-by-step procedures for non-Commodore equipment.

I. There is no video display.

Symptom Your computer system has power and everything seems to be operating, except that you have no video display whatsoever.

Diagnosis The problem may lie in the monitor, the computer itself, or possibly in the power supply, although the last is least likely. Most causes of this symptom are serious, and your system may require professional repair. However, it is a good idea to follow the step-by-step guide, at least to get an accurate diagnosis.

Treatment

1. Check that your system is getting power. First, make sure that the power cord connecting the monitor to the system unit is securely in place. It's a good idea to remove it and then reconnect it firmly and carefully. It is also advisable to check the household power supply, although it is not a likely cause if your computer is operating smoothly otherwise.

2. Check the brightness and other controls on the monitor. Someone may have turned the controls so that nothing is visible on the screen. In that case, fiddling with the knobs should bring the display back to life. If that doesn't work, check that the knobs are securely in place, since they may not be operating correctly and could be throwing the display off. If the knobs are not working properly, take the monitor to a computer or television repair shop.
3. Try your monitor on another system. The problem may not lie in your monitor, but in the system itself. You can test your monitor on a friend's or dealer's system (it doesn't have to be a Commodore) to see if it is working properly. If it is, the problem is obviously with your computer system. If the monitor doesn't work correctly on other systems, take it to a dealer or television repair shop. If you use a television set as a monitor, it is even easier to determine where the problem lies. Just disconnect it from the computer, plug it into a wall socket, and see if it works correctly. If so, you have a system problem. If not, get your television fixed.
4. If you have determined that your monitor or television set is functioning correctly, then the problem is probably in the memory or logic functions of the computer system. The best solution now is to take your system to a repair shop or dealer.

II. The video display fades in and out.

Symptoms The display can have any number of problems. These include fading in and out, breaking up, vertical or horizontal flipping, or other symptoms that are familiar to any television viewer.

Diagnosis Most of these problems originate in the monitor or television set and respond to either a simple adjustment or a trip to the repair shop. Other failings, such as fading in and out or electrical interference, may be due to power supply or environmental problems. Finally, some of these symptoms can be caused by failing elements in the computer system itself.

Treatment

1. If the screen display is fading in and out or is simply not bright enough, try adjusting the brightness and contrast controls. If this doesn't work or works only for a while, you may have to take the set in for repair.
2. If the problem is vertical or horizontal flipping, try adjusting the vertical or horizontal hold buttons on your monitor or television set. Many monitors do not have external controls for vertical and horizontal hold, so you will have to take the set to a repair shop. However, be sure to get an estimate, since this should be a fairly simple repair, provided it requires only an adjustment. Some of these symptoms, however, could be due to failing components that need to be replaced. In this case, the repair bill will be higher.
3. Check your household or office power supply. Power supply disturbances, including brownouts and electrical storms, can cause problems. Even transients on the power line might be causing these problems, especially if your display is fading in and out. Problems with power surges and other transients usually respond to a surge protector. (See Chapter 2 for a discussion of power supply problems and surge protectors.) Also remember to check that your monitor is securely plugged in.

4. Try swapping monitors or television sets. If you can borrow another monitor from a friend or a dealer, test it on your system. If it works properly, then your own monitor is probably faulty. If it doesn't work or displays the same symptoms, then you may have a computer system problem.
5. Use your diagnostic software to check memory/logic failure. The failure might be in the sections of the computer's memory that affect the video display. If so, diagnostic software that checks for memory failure may be able to pinpoint the problem. If failing memory is the culprit, you can either take your system to the shop (with your diagnosis in hand) or consult the video function chip substitution section later in this chapter.

III. The monitor is overheating.

Symptom The monitor or television set is hot to the touch. This, in turn, may be causing problems with the display.

Diagnosis The ventilation outlet may be blocked, preventing the monitor from cooling. Another possibility is that a failing component is causing the monitor to overheat.

Treatment

1. Make sure that a book, piece of paper, or some other object is not blocking the ventilation outlet on the monitor.
2. Check to see that no dust or other material is clogging the outlet. If it is, turn off the monitor, unplug it, and carefully remove the housing. Clean the outlet either with a damp rag or with a pressurized gas duster.

3. If your monitor is still overheating, take it in for repair. You probably have one or more failing components.

Video Function Chip (IC) Substitution

Although repairs on the video monitor itself should be left to a professional, there are chips on the console main board that may have caused video malfunctions.

One important chip that may need to be replaced is the video interface chip (U19). Another possible culprit is the RF modulator, which can also be replaced (see Figure 5–7 for location). Refer to Chapter 5 for procedures for replacing chips.

Video Monitor Toubleshooting Chart

I. There is no video display.

Diagnosis	Treatment
Loose or defective power cords, cables, plugs	Check that all are properly inserted and intact.
Improperly set brightness and other controls	Adjust controls.
System board failure	Swap monitors; replace if defective, otherwise test system board functions.

II. The video display fades in and out.

Diagnosis	Treatment
Improperly set brightness or other controls	Adjust controls.
Environmental source	Correct or wait until it subsides (e.g., electrical storm).
Household power supply problem	Check household voltage.

Faulty tube or other monitor element	Swap monitors; if faulty, take for professional repair.
System board failure	Check with diagnostic software.

III. The monitor is overheating.

Diagnosis	**Repair**
Clogged or blocked ventilation outlet	Clean or unblock outlet.
Monitor	Swap, then take for repair.

7

Troubleshooting the Disk Drive and Cassette Recorder

Disk drives or cassette recorders are integral parts of your Commodore 64 system and must be in good operating condition for your computer to function smoothly. This chapter outlines troubleshooting and repair techniques for both disk drives and cassette recorders.

Disk Drives

Disks and disk drives, especially the floppy disks commonly used in personal computers, are among the most vulnerable elements of your computer system. There are several reasons for this.

First, disks are subject to environmental wear and tear, including heat, humidity, direct light, bending, spilling, magnetism, and other hazards. Unless you take good care of your disks, they can cause you trouble, including loss of data and damage to your disk drive.

Second, the disk drive itself is subject to wear and tear since it is, after all, a mechanical device with a motor that can develop problems, a drive mechanism that can go out of alignment, and read/write heads that can get dirty or wear out.

For the computer owner, this means that preventive maintenance, cleaning, and careful repair are especially important for disks and disk drives. Disks should be protected from dust and accidents.

Disk drives should be kept as dust-free as possible, too. This means keeping the latch covers closed and putting a dust cover on the disk drive when it's not in use. In addition, the heads of the disk drive should be cleaned every 100 to 200 hours of use, or once or twice a year for the average system. Chapter 2 treats proper care and preventive maintenance for your disks and disk drive in detail. This chapter outlines troubleshooting techniques for the most common problems of disks and disk drives.

The Commodore 1541 disk drive (Figure 7–1) uses 5¼-inch floppy disks, which function as all disks do. The purpose of disks is to store information outside the system's memory. Disks are, after all, storage media.

The disks are essentially magnetic platters that work much as phonograph records do. Inside their plastic covers, the disks are turned at high speed by the disk drive. The read/write head is both the recording and playback unit, which stores and retrieves information electromagnetically on the surface of the disk.

Because the read/write head of the disk drive comes in contact with the surface of the disk, the head can become dirty or worn. This, in turn, causes read/write problems that show up as errors in the operation of the computer system.

Another read/write problem arises when dirt, dust, smoke, or other foreign material finds its way onto the surface of the

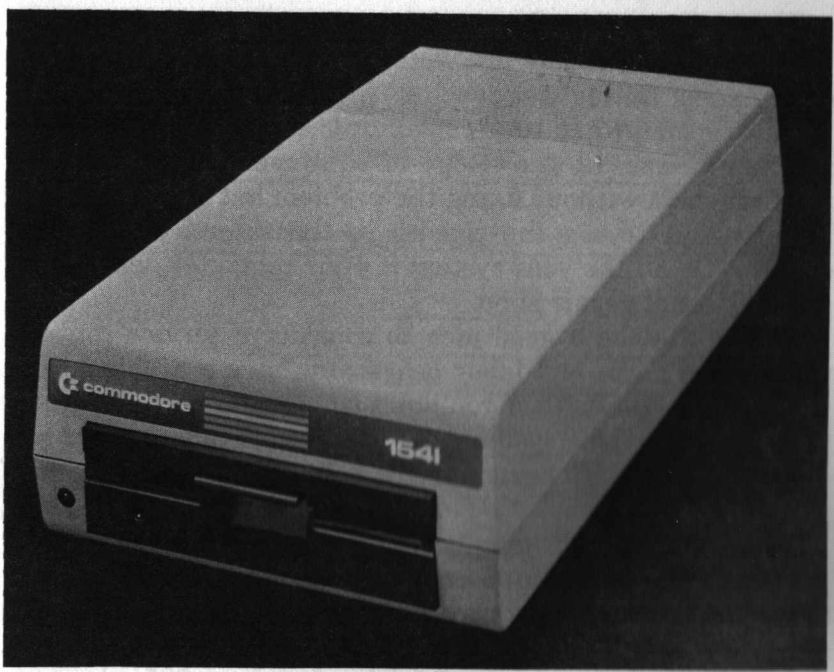


FIGURE 7–1 Commodore 1541 Disk Drive

disk. Even a tiny speck of dust can disturb the delicate read/write process and show up as an error.

In addition, the spinning of the disks by the disk drive must be a very exact process. Over time, disk drives get out of alignment and must be realigned. Also, the various mechanical components of the disk drive, such as the drive belt, can wear out. If so, they must be replaced.

The first part of this chapter sets forth simple troubleshooting of common problems with the disk drive and some basic procedures for solving these problems. However, few of these basic procedures involve complicated diagnosis or repair.

The second part of the chapter sets forth step-by-step troubleshooting and repair procedures for fixing your disk drive or replacing failing components. Although some of these repairs are somewhat time-consuming and exacting, they do not require special knowledge or equipment. If you exhaust the first steps without fixing the problem but do not feel confident about trying the repairs in the second part of this chapter, then take your system to your computer dealer or to a professional repair shop.

It may also be a good idea to consider a service contract that covers parts and labor *before* you have a problem with your disk drive. Even if you don't want to buy a service contract for your whole system, your dealer and independent service companies will cover specific elements of your system if you wish.

Since disk drives (along with printers) are one of the main problem areas of a computer system, it is important to know Commodore's repair policy before a problem develops. If you send your malfunctioning disk drive back to Commodore, they will repair or replace the drive for about $85, plus one-way shipping charges.

When you consider that virtually any repair on your disk drive will probably cost at least that amount or more, the manufacturer's repair seems like a good deal. Of course, if you believe the problem is fairly minor and you can repair it yourself, then you may be able to save.

Remember, however, that once you go inside and try to repair the disk drive yourself, Commodore may balk at repairing it if your attempt at repair is a disaster. Be sure to review the chapter on manufacturer's warranty and service before you decide what to do.

Commodore 1541 Disk Drive

The Commodore 64 disk drive is the 1541 model (see Figures 7–1 through 7–3), which is produced by two different manufacturers, Alps and Newtronics. Although there are slight

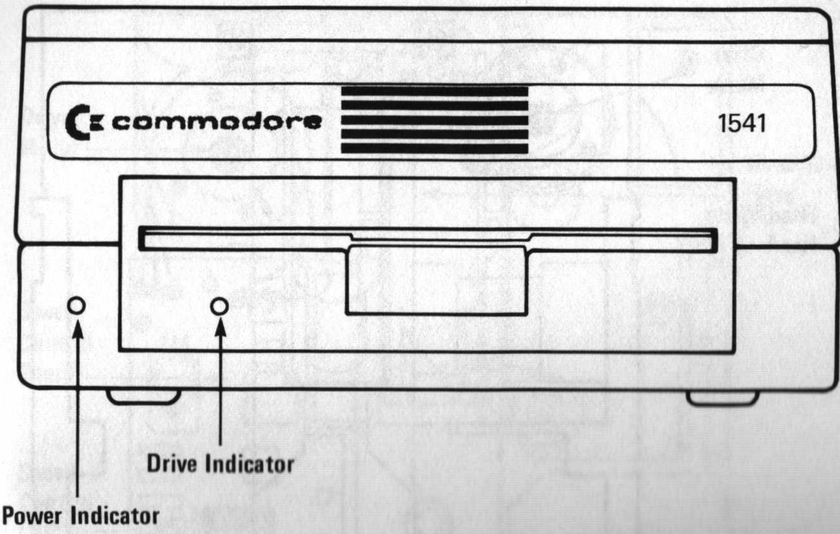

commodore
1541
Drive Indicator
Power Indicator

FIGURE 7–2 1541 Disk Drive: Front View

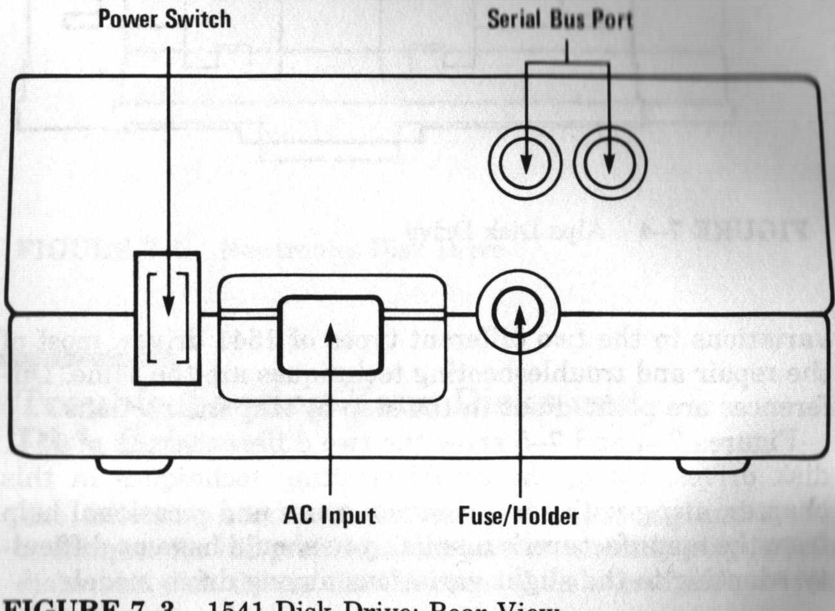

Power Switch
Serial Bus Port
AC Input
Fuse/Holder

FIGURE 7–3 1541 Disk Drive: Rear View

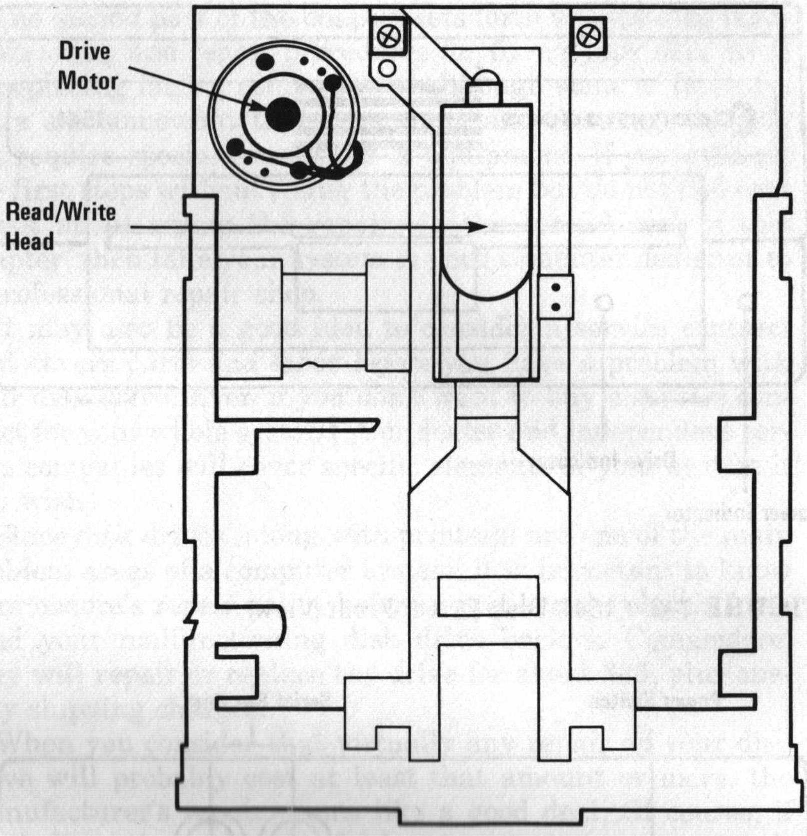


FIGURE 7–4 Alps Disk Drive

variations in the two different types of 1541 drives, most of the repair and troubleshooting techniques are the same. Differences are pointed out in the step-by-step instructions.

Figures 7–4 and 7–5 show the two different types of 1541 disk drives. Using the troubleshooting techniques in this chapter, along with some common sense and occasional help from the manufacturer's manual, you should have no difficulty adapting to the slight variations among drive models.

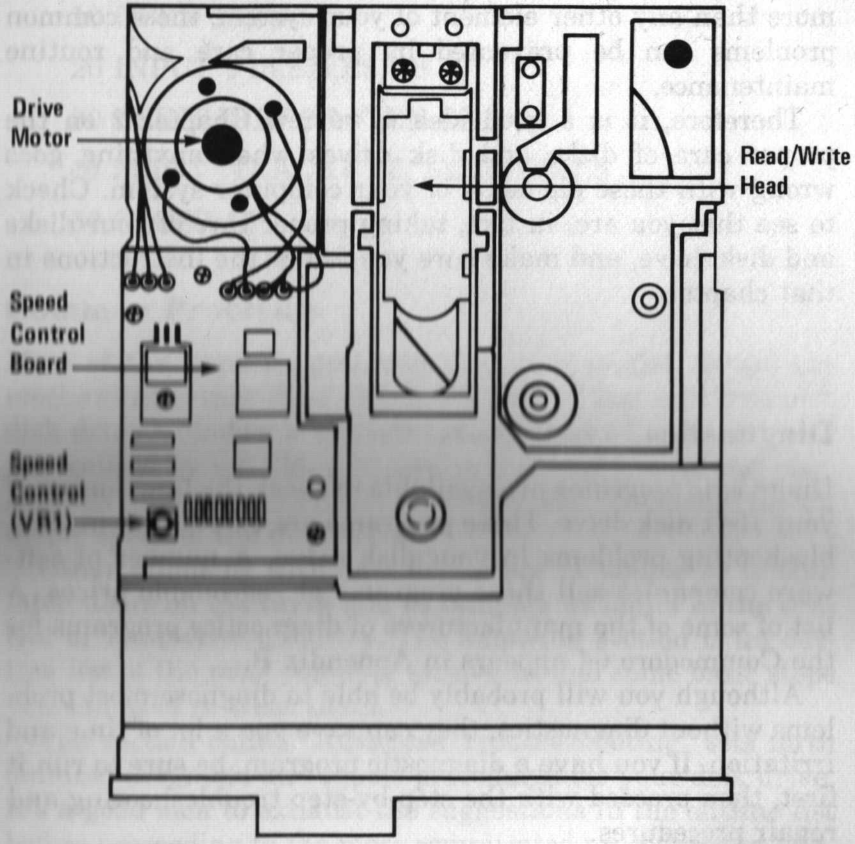

Drive Motor
Read/Write Head
Speed Control Board
Speed Control (VR1)

FIGURE 7–5 Newtronics Disk Drive

Troubleshooting Your Disks and Disk Drive

The following section describes troubleshooting and repair techniques for the problems that most commonly plague your disks and disk drives. In the case of disks and disk drives, more than any other element of your system, these common problems can be prevented by proper care and routine maintenance.

Therefore, it is a good idea to review Chapter 2 on the proper care of disks and disk drives when anything goes wrong with those elements of your computer system. Check to see that you are, in fact, taking proper care of your disks and disk drive, and make sure you follow the instructions in that chapter.

Diagnostics

Diagnostic programs are available to check the functioning of your 1541 disk drive. These programs are very useful in troubleshooting problems in your disk drive. A number of software companies sell these programs at reasonable prices. A list of some of the manufacturers of diagnostics programs for the Commodore 64 appears in Appendix B.

Although you will probably be able to diagnose most problems without diagnostics, they can save you a lot of time and irritation. If you have a diagnostic program, be sure to run it first, then proceed with the step-by-step troubleshooting and repair procedures.

Disk Drive Error Signal

Another way to diagnose errors in the operation of your disk drive is to retrieve an error message from your disk drive memory. The blinking of the red LED light on the front of your disk signals an operational error; this means an error message is stored in the drive's memory. If you can successfully run the following BASIC program, you may be able to retrieve the error message, along with the error number, track, and sector.

```
10 OPEN 15,8,15
20 INPUT #15,EN,E$,T,S
30 PRINT "ERROR#";EN,E$
40 PRINT "TRACK#";T,"SECTOR#";S
50 CLOSE 15
```

Common Problems

Most of the common problems that plague disk drives are mechanical rather than electronic. One of the most frequent disk drive maladies is malfunctioning read/write heads, usually caused by a buildup of dust or by simple wear and tear. Another problem, often due to heavy use, is change in the motor speed of the disk drive.

Other problems with disk drives are as simple as broken latch doors on the drive and as complex as faults in the control or read/write circuitry. The following section is an outline list of the most common symptoms and some basic steps you can take to treat them.

The section called "Advanced Troubleshooting" sets forth detailed diagnosis and repair procedures for your disk drive. It's a good idea to exhaust the suggestions in the outline list before proceeding to the more complicated procedures in "Advanced Troubleshooting."

I. The system has power, but the drive doesn't respond to commands.

Symptom The system has power, but the disk drive does not respond to commands, such as the booting command, and appears dead.

Diagnosis The disk drive is not operating at all for one of several reasons. Either it is getting no power, the motor is not functioning correctly, or there is a problem with the cables, the drive circuits, or the system circuits.

Treatment

1. Just to make sure disks are not the source of your problem, check your disks for physical damage, including scratches, dust, or bending. Also check that you have inserted the disks correctly. Do they fit into the drive smoothly, or is there some physical impediment? A broken part or extraneous object may be interfering with your drive. Since you would probably hear the motor grinding or trying to work, this cause is unlikely. However, it is worth checking if you think something has gotten into your disk drive. For a description of this procedure, see "Advanced Troubleshooting," which treats removal of the disk drive.
2. Check your household power supply. Make sure that the disk drive is securely plugged in and that the power cord is not defective.
3. You may have a problem with your motor, including a broken drive belt, a burned-out motor, or other mechanical failure. You can check for a broken or loose drive belt by examining the underside of the disk drive. If you discover a broken belt, you can easily replace it yourself. However, if the belt is broken and the alignment is bad, then you will probably have to take the drive to a repair shop for realignment.

II. The drive operates but will not boot.

Symptoms The disk drive has power and seems to respond when you give the booting command, but it does not boot.

Diagnosis The most likely reason for this common problem is damaged, badly programmed, or incompatible software. Other possibilities are bad alignment, incorrect drive speed, or a mechanical problem with the motor. This problem may also be due to a dirty drive head or, more seriously, bad drive circuits.

Treatment

1. Remove the disks, reinsert them carefully, and try to boot again.
2. Try another software disk. There may be a software error in (or physical damage to) the original disk.
3. If you have a diagnostics diskette, test the disk drive with it. You may have an alignment or motor speed problem. If the diagnostics indicate a motor speed problem, you can adjust that yourself by following the step-by-step procedures in "Advanced Troubleshooting," below. An alignment problem, however, requires professional attention.
4. Remove the disk drive from its cover (see "Removing the Disk Drive Cabinet and Chassis," later in this chapter) and check underneath to see if the drive belt is intact. If it is broken or loose, replace it following the repair procedure in "Advanced Troubleshooting."
5. You may have a mechanical problem such as a failing motor. Refer to "Advanced Troubleshooting," below.
6. Problems with booting may also be caused by a dirty drive head. You may try cleaning the head with a head-cleaning kit. If this doesn't work, test the drive head using the procedures set forth below.

III. The disk drive works but makes noise.

Symptoms The disk drive operates but is making unusual noises. These noises vary; a common one is a grinding sound as if some extraneous object is caught in the drive.

Diagnosis A number of causes could be at the root of the mysterious noise in your disk drive. An improperly inserted disk might be the cause. It might also be a foreign object or loose part that is jamming the disk drive, or it could be a problem with the alignment or motor speed. There may also be a normal chattering, which occurs when you use a copy-protected disk. This chattering should last for only about three seconds.

Treatment

1. Remove the disk you are working with and reinsert it carefully. Check that you can insert and remove it freely. If it doesn't go in and out smoothly, something might be blocking it. If you suspect such a problem, turn off the system, remove the drive cabinet, and check if some foreign object is causing the trouble. The problem might lie with the eject mechanism of the disk drive, which may in turn be jamming your drive.
2. If you have a diagnostics disk, test the disk drive with it. What you are looking for in particular is whether the motor speed needs adjusting or the drive needs aligning. Adjusting the motor speed of your disk drive is a fairly simple procedure, described in "Advanced Troubleshooting." If you don't want to adjust it yourself, take the drive to a repair shop with your diagnosis in hand. Alignment of the disk drive is more complicated and best left to professionals.

IV. The disk drive has read/write problems.

Symptoms The computer displays strange characters (junk) on the screen. This happens either when the computer is reading material already on your disk, and/or when you try to write new material on the disk. (Before you blame the disk drive, you should first read the section in Chapter 5 that deals with this problem in the console or keyboard. Once you have ruled it out as the root of the problem, then you can turn to the disk drive.)

Diagnosis Unless you simply are trying to work with a bad or incompatible disk, or have a software problem, the blame probably lies with the read/write head of the disk drive, the drive speed, or a failing chip.

Treatment

1. Remove the disks you are working with and inspect them for physical damage. If they look intact, reinsert them carefully. If they still don't work, try swapping disks.
2. Check the software you are using for errors. For example, a software bug might be preventing you from completing certain operations. It is a good idea to try another software program first before you blame the hardware.
3. Check cabling, power supply, and environmental problems. Make sure that all external cables connected to the expansion drives are securely plugged in and are not defective.
4. Swap drives to determine if the problem is indeed in the drive itself.
5. If you have a diagnostics disk, check for the disk drive's read/write ability. If you have a read/write

problem, you should begin by cleaning the heads on your disk drive. The easiest way to clean the heads is with a head-cleaning kit, available in most computer stores and priced at around $25. Each package provides about thirty cleanings, so a kit is a good investment in future maintenance.

6. If you have a diagnostics disk, you may also be able to check the motor speed and alignment of the disk drive. If the test indicates a motor speed problem, you can adjust the motor speed yourself. However, alignment problems require professional help.
7. If none of these measures solve the difficulty, then you may have a failure in the read/write head. If so, replace it following the procedures in "Advanced Troubleshooting," take the disk drive to a repair shop, or send it to Commodore for repair.

V. It is difficult to insert and remove disks.

Symptoms The disks seem to jam when you insert or remove them; they don't slide in and out properly.

Diagnosis The loading mechanism of the disk drive has various mechanical parts. One or more of these parts may be bent or loose, or extraneous objects may have found their way into the disk drive.

Treatment

1. Check first that the disk itself is not bent and is not the cause of the problem.
2. Before removing the disk drive cabinet, examine the outside of the disk drive loading area. Is the latch intact? Is anything obviously jamming the opening? Remove it gently, if possible.

3. Remove the disk drive cabinet (see "Removing the Disk Drive Cabinet and Chassis," later in this chapter). Check to see if any part is obviously loose or bent. The problem may be as simple to correct as a loose screw. Most disk drives contain a fairly simple mechanism for ejecting the disk when you open the latch on the drive. If one of the parts of this mechanism is broken or has slipped out of place, it is fairly simple to fix or replace it.

Advanced Troubleshooting

Before you get into the more complicated troubleshooting and repair techniques described in this section, make sure you have exhausted the troubleshooting suggestions earlier in the chapter. These include checking the physical integrity of your diskettes, ruling out software problems, making sure you have a clean and steady household power supply, and checking the drive for foreign objects. If none of these steps solve the problem, then you are ready for more advanced troubleshooting procedures.

Diagnostics

If you have a diagnostic program, then the first step in locating the problem is running the diagnostics. If you can run these tests successfully, you will save a lot of time in diagnosing the problem. Although the diagnostics are not foolproof, they do give a good indication of the probable cause of the difficulty and generally suggest corrective action.

Swapping Drives

If you have a dual-drive system, your diagnostics may indicate which drive has caused the error. However, if your diagnostics don't give you this information, try swapping drives before you go any further. To swap drives:

1. Making sure that the system is turned off and all power cords and cables are unplugged, unplug the drive connectors and swap them.
2. If the diagnostic code is the same and the symptoms remain, then the problem is probably not in the drives. If the code changes to indicate the swap or the symptoms change, then you can tell which drive is at fault.
3. If you are getting no power or having trouble with the diagnostics, you may also try operating only one drive at a time to see if one is crashing the system.

Checking Voltage on the Disk Drive

You can detect or verify a number of problems by checking voltage readings on the disk drive. When taking these readings, be sure to follow the safety precautions outlined in Chapter 4. Some of the voltage reading procedures and subsequent diagnoses are tricky. If you are not confident about taking these readings and making a diagnosis, you might want to have a professional repair person make the diagnosis. Then you can proceed with the repairs yourself.

The following sections set forth procedures for checking the voltage readings at various test points on your disk drive, for both Alps and Newtronics model drives. It is also a good idea to refer to the drive manufacturer's own manual if you have access to it.

Figure 7–6 illustrates the locations of the test points on the drive. Follow the voltage reading procedures in order, since they are designed to eliminate various possible diagnoses in sequence.

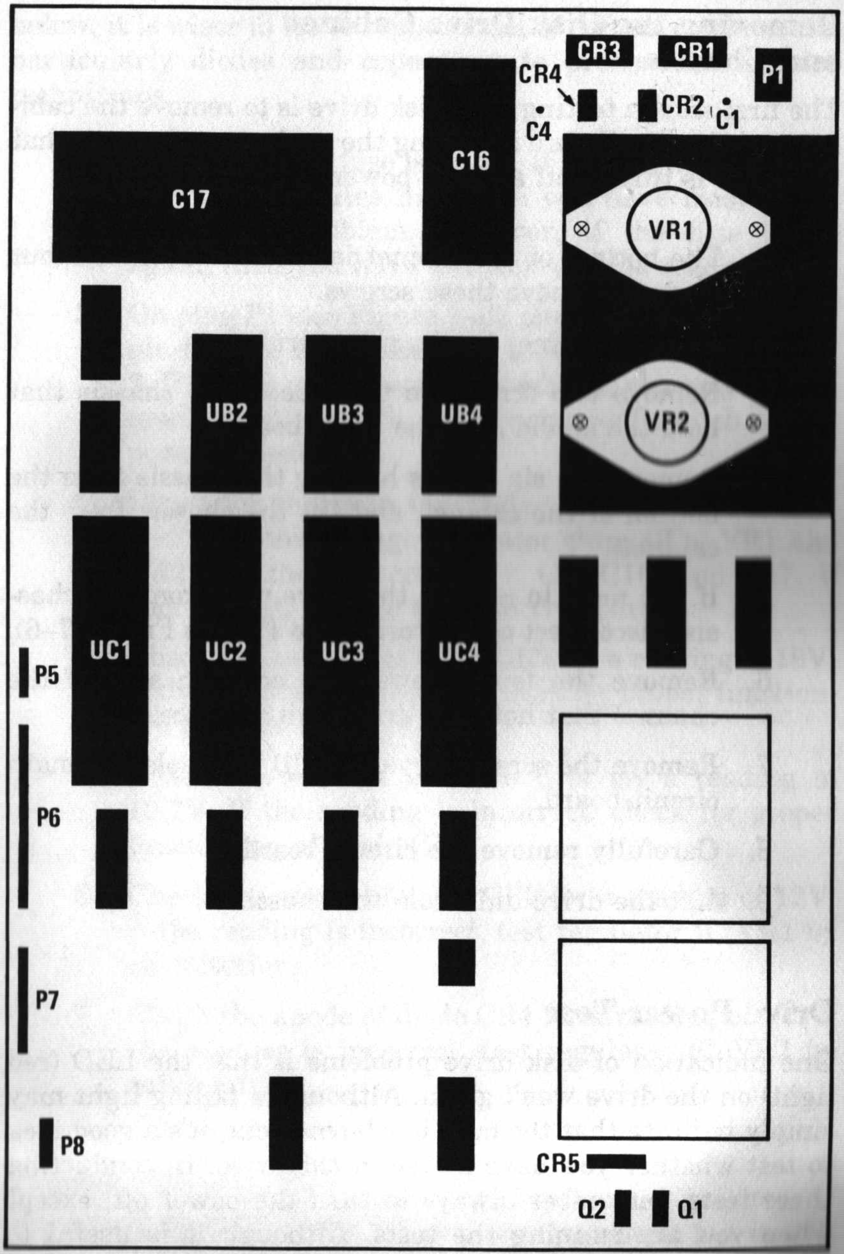

CR3
CR1
P1
CR4
C4
CR2
C1
C16
C17
VR1
VR2
UB2
UB3
UB4
UC1
UC2
UC3
UC4
P5
P6
P7
P8
CR5
Q2
Q1

FIGURE 7–6 1541 Disk Drive: Main Board

Removing the Disk Drive Cabinet and Chassis

The first step in testing your disk drive is to remove the cabinet and chassis. Before removing the cabinet, make sure that the drive is turned off and the power cord is unplugged.

1. The bottom of the cabinet is held to the top by four screws. Remove those screws.
2. Lift the cabinet top from the drive unit.
3. Remove two screws on the side of the chassis that hold the shield over the main board.
4. Remove the six screws holding the chassis from the bottom of the cabinet, and lift the chassis from the cabinet.
5. If you need to remove the drive unit from the chassis, disconnect connectors P5 to P8 (see Figure 7–6).
6. Remove the four screws (two on each side of the chassis) that hold the drive unit in place.
7. Remove the screws (seven in all) that hold the main circuit board.
8. Carefully remove the circuit board.
9. Lift the drive unit from the chassis.

Drive Power Test

One indication of disk drive problems is that the LED (red light) on the drive won't go on. Although a failing light may simply indicate that the bulb has burned out, it's a good idea to test whether you have power in the drive. In conducting these tests, remember always to turn the power off, except when you are running the tests. Although it is useful to check for proper functioning of all the components described below, it is wiser to leave replacement of certain components, particularly diodes and capacitors, to professional service technicians.

1. Check that the fuse is intact. If not, replace it. If the computer operates fine, then you have most likely solved the problem. However, if the fuse blows again, then you have to check voltage readings.
2. On plug P1 (see Figure 7–6), check for 15.5V ac from pin 1 to pin 4, and check for 9.7V ac from pin 2 to pin 3. If you do not get correct readings, you may have a problem either with the power on-off switch or the power transformer.
3. Check for shorts in the bridge rectifier diodes CR1 and CR3, the voltage regulator chips (ICs) VR1 and VR2 and the capacitors C1, C4, C16, and C17. If shorts exist, replace the defective part.
4. Check the cathode of diode CR2 for a reading of 18V. If the reading is incorrect, check for proper functioning of diode CR1.
5. Check the cathode of diode CR4 for a reading of 10.7V. If the reading is incorrect, check for proper functioning of diode CR3.
6. Check the anode of diode CR2 for a reading of 12V. If the reading is incorrect, test regulator IC VR1 by substitution.
7. Check the anode of diode CR4 for a reading of 5V. If the reading is incorrect, test regulator IC VR2 by substitution.

Repair Procedures

If you determine that the drive is getting power but is still not operating, then perform the step-by-step procedures de-

Table 7–1 Disk Drive Main Board Replacements

Symptom	Component
No power	On/off switch Power transformer Diode CR1 Diode CR3 Regulator VR1 Regulator VR2
Motor problems	UC1 UC2
Read/write problems	UC1 UC2 UC3 UC4 UB2 UB3 UB4

scribed below. Note that these procedures require using a logic probe. If you are not confident about using a logic probe, then it may be time for professional help.

There are a number of reasons why a disk drive won't perform, for example, the load or save functions. These range from a broken drive belt to malfunctioning chips.

Although you can make lengthy tests to determine if the chips are functioning correctly, it is generally easier simply to substitute chips or other components. Most professional repair people substitute chips rather than take chances on logic or voltage readings. Table 7–1 lists symptoms and components which may have failed. Table 7–2 lists the components and manufacturer's identification numbers for replacement.

Two important ICs, which control most disk drive functions, are the controller IC UC1 and the interface IC UC2. Once you have checked for power supply problems, mechanical failure (such as a broken drive belt), and dirty read/write

Table 7–2 Disk Drive Board Parts Numbers

Component	Manufacturer's Number
CR1	900746-01
CR2	900750-02
CR3	900756-01
CR4	900750-02
F1 (Fuse)	903555-20
SW1 (Power on/off switch)	904509-01
T1 (Power transformer)	1540009-02C
UB2	325502-01 325502-03
UB3	323502-01
UB4	901437-01
UC1 (Controller IC)	325572-01
UC2	901437-01
UC3	901437-01
UC4	901435-01
VR1	901528-04
VR2	901528-03

heads, try substituting chips. The following section outlines step-by-step procedures for troubleshooting specific problems and chip substitution.

Drive Motor Problems If the drive motor does not rotate the disk, follow the procedures below.

1. Check the drive belt. If it is broken, replace it according to the procedure described later in this chapter. Note that a broken drive belt may result in bad

drive alignment, in which case your drive will have to be aligned by a professional.

2. Giving a load or save command to the computer, test for a low logic reading at pin 3 of connector P5.
3. If the reading is incorrect, substitute the controller IC UC1 and the interface IC UC2.
4. If chip substitution doesn't solve the problem, then check the motor speed adjustment, following the procedure set forth later in this chapter.

Stepping Motor Problems If the stepping motor, which controls the read/write head, is not operating correctly, try the following procedures.

1. Check connector P7 with your voltmeter for bad connections.
2. If the connections are good, then substitute controller IC UC1 and interface IC UC2.

Write Function Problems If the drive has problems with the write function, then try the following steps.

1. Check that the connections on the head connector P8 are good. Check for 16.4 ohms of resistance between pins 1 and 4, and for 17.1 ohms of resistance between pins 4 and 5.
2. If the readings are good, then substitute controller IC UC1 and interface IC UC2.

Read Function Problems

1. Check that the connections on the head connector P8 are good. Check for 16.4 ohms of resistance between pins 1 and 4, and for 17.1 ohms of resistance between pins 4 and 5.

2. If the readings are correct, substitute, in turn, interface ICs (UC3 and UC2), CPU IC (UC4), RAM IC (UB2), ROM ICs UB3 and UB4 and controller IC UC1.

Erase Problems

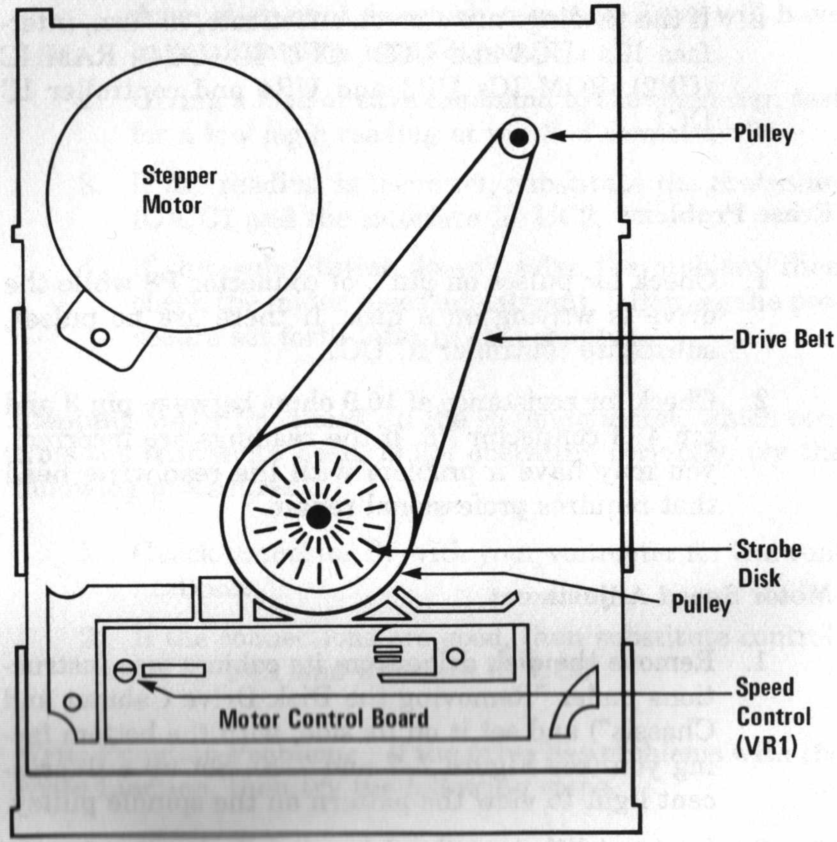
1. Check for pulses on pin 3 of connector P8 while the drive is writing on a disk. If there are no pulses, substitute controller IC UC1.
2. Check for resistance of 10.9 ohms between pin 3 and pin 4 of connector P8. If the readings are incorrect, you may have a problem with the read/write head that requires professional repair.

Motor Speed Adjustment

1. Remove the disk drive from its cabinet (see instructions under "Removing the Disk Drive Cabinet and Chassis") and set it on its side, with the bottom facing you (see Figure 7–7 and 7–8). Set up a fluorescent light to view the pattern on the spindle pulley.
2. Insert a disk into the drive and load a program to start the motor.
3. Using a screwdriver, slowly turn the speed control VR1 (see Figure 7–5 or 7–7) until the pattern no longer seems to spin. *(Note:* If you are using 60Hz ac power, then refer to the outer trace of the spindle; if you are using 50Hz ac power, refer to the inner trace.)

Removing and Replacing the Disk Drive Belt

1. Turn off all power switches and unplug all cords and cables.



Stepper Motor
Pulley
Drive Belt
Strobe Disk
Pulley
Speed Control (VR1)
Motor Control Board

FIGURE 7–7 Alps Disk Drive: Bottom View

2. Remove the disk drive from its cabinet (see instructions under "Removing the Disk Drive Cabinet and Chassis").
3. Gently place the disk drive on a table, drive belt and pulleys facing up.

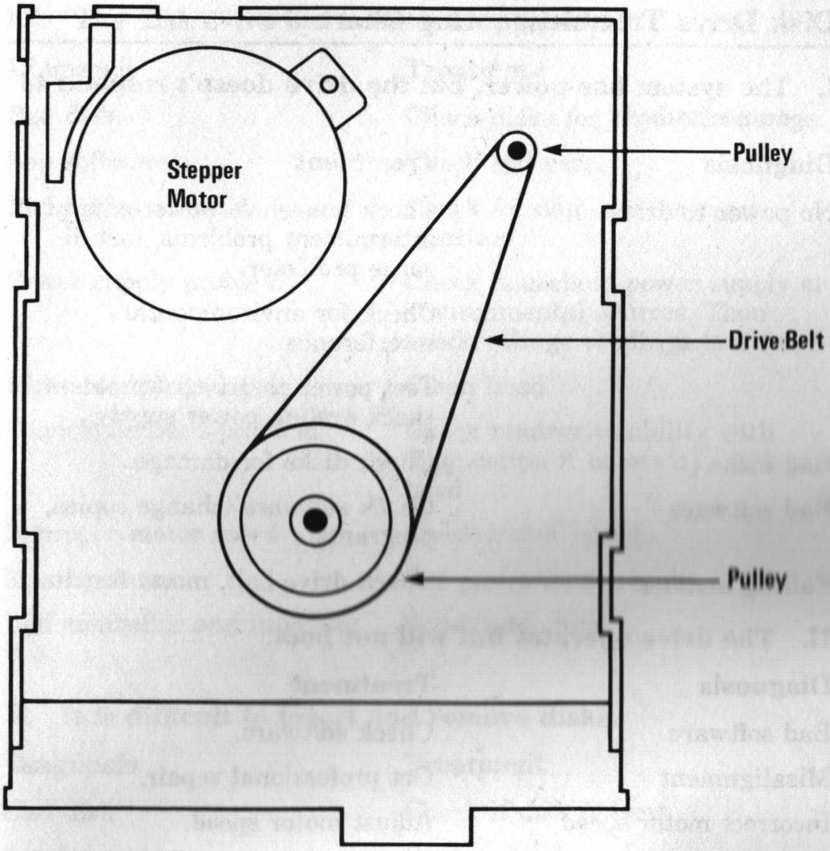

Stepper Motor
Pulley
Drive Belt
Pulley

FIGURE 7–8 Newtronics Disk Drive: Bottom View

4. Lift the belt off the large pulley first, then off the small pulley.
5. Take the new belt and put it around the small pulley first, then around the large pulley.
6. Replace the disk drive and the unit cover.

Disk Drive Troubleshooting Chart

I. The system has power, but the drive doesn't respond to commands.

Diagnosis	Treatment
No power to drive	Check household power supply; if intermittent problems, install surge protector.
	Check for environmental interference.
	Test power to drive; if problem, check system power supply.
Bad disks	Check disks for damage.
Bad software	Check software (change copies, programs).
Failing motor	Check drive belt, motor functions.

II. The drive operates but will not boot.

Diagnosis	Treatment
Bad software	Check software.
Misalignment	Get professional repair.
Incorrect motor speed	Adjust motor speed.
Faulty drive belt	Replace drive belt.
Failing motor	Check motor functions, replace motor.

III. The disk drive works but makes noise.

Diagnosis	Treatment
Improperly inserted disk	Check disk.
Copy-protected disk	Wait several seconds; if sound continues, check software.
Blocked or jammed drive	Check for foreign objects.
Improper motor speed	Adjust motor speed.
Misalignment	Get professional repair.

IV. The disk drive has read/write problems.

Diagnosis	Treatment
Bad disks	Check disks for physical damage.
Bad software	Check software.
Bad cables or cords	Check for damage, incorrect insertion.
Power supply problem	Check household power supply or environmental sources. Then check voltage readings to drive.
Dirty read/write head	Clean head.
Read/write head problems	Check read/write ability with diagnostics; if necessary, replace head.
Improper motor speed	Check motor speed.
Misalignment	Get professional repair.
Bad controller and interface ICs	Substitute chips.

V. It is difficult to insert and remove disks.

Diagnosis	Treatment
Bad disk	Check if disk is bent.
Latch problem	Replace latch.
Loose part	Check for loose screw or part.
Foreign object	Check for foreign object in drive.

Cassette Drive

Many Commodore 64 owners use a cassette recorder (Figure 7–9) on their systems. Although cassette recorders do not have the storage capacity of disk drives, they are inexpensive to buy and operate and easy to duplicate.

The care requirements of cassette drives are similar to those of disk drives, although tapes are somewhat more dura-

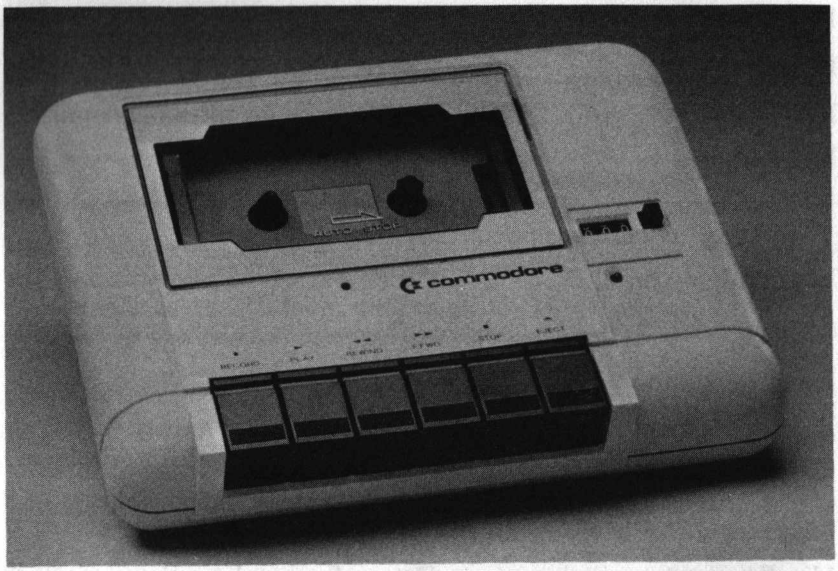


FIGURE 7–9 Commodore Cassette Drive

ble than disks. Still, they must be kept away from heat and sunlight and relatively free of dust, dirt, and foreign matter. They should also be cleaned regularly with head-cleaning kits.

Common Problems

Most problems with cassette drives are the result of damaged tape, dirty recording heads, or a jammed or failing operating mechanism. As with disk drives, routine maintenance and regular cleaning go a long way toward preventing cassette drive problems.

Repair of mechanical problems in cassette drives is really in the field of audio troubleshooting; however, most of the mechanical parts are fairly simple, and obvious mechanical problems can usually be diagnosed easily.

If you don't feel confident about repairing the cassette drive yourself, take it to your computer dealer or a repair shop. Most cassette drive repairs are somewhat less costly than other computer repairs. You might also consider going to an audio store repair shop, where repair people are more familiar with the technology and labor rates are likely to be substantially lower as well.

I. The cassette drive doesn't work at all.

Symptoms The cassette drive just sits there like a dead fish when you try to operate it.

Diagnosis You have either a household power supply problem or a dead drive motor.

Treatment

1. Make sure the cassette cord is firmly inserted into the console. Also check the card-edge connector at the end of the connecting cord to make sure it isn't damaged or dirty.
2. Your cassette drive mechanism might be so jammed that it appears dead. Open the top of the drive and make sure that the spindles move freely and that nothing is jamming the cassette mechanism.
3. You may also have a dead motor or possibly a malfunctioning transformer. Take the cassette drive in for repair or refer to the advanced troubleshooting procedures below.

II. The cassette drive works but makes noise or operates slowly.

Symptoms The cassette drive seems to be struggling to function or operating at low or varying speeds.

Diagnosis The tape may be twisted, the transport mechanism may be jammed with some foreign object or substance, or the drive motor or other part of the drive mechanism may be failing.

Treatment

1. Check the cassette to see that the tape is not twisted and that the spindles are free. If the tape is twisted or has slipped out of position, very gently return it to its proper place, being careful not to smudge or dirty the tape. If the tape is not accessible, you may be able to coax it back into position by shaking the cassette or giving it a sharp rap on your desk. If none of these measures are successful, take the cassette to your computer dealer or audio store for help.
2. If the tape is not twisted but still runs slowly, then the traveling mechanism for the tape may be dirty, jammed, or otherwise malfunctioning. It is fairly simple to remove the cover of the cassette drive to clean and lubricate this mechanism. For these cleaning procedures, see Chapter 3.
3. Check the motor to make sure it is operating correctly and is free of obstructions. If it seems to be lumbering or making noises, take it in for repair.
4. Make sure that the control switches, such as playback and record, are operating correctly. Switches that slip out of position can cause problems. It is fairly simple to replace these switches, or you can take the recorder to an audio shop or computer dealer for repair.

III. The cassette drive has input or output problems.

Symptoms The cassette drive is in good working order, but it's not doing its job. There is no output or input of data from the cassette to the system; for instance, the cassette won't load programs into the computer.

Diagnosis There are several possible causes, including a bad cassette, tape cassette head, loose or faulty cables, or problems with the cassette drive's audio circuitry.

Treatment

1. Try substituting another cassette in the drive. If it works, then the original cassette was probably bad.
2. Check the cord from the drive to the console. Make sure the cord is plugged in securely and is not defective, and check the connectors on the console and drive to make sure they are not loose or otherwise faulty.
3. Clean the head of the cassette drive with a head-cleaning kit, described in Chapter 2. Your tape head may need realignment, which requires professional repair.
4. If you still have a problem, the culprit may be a chip failure in the console, which requires professional diagnosis and repair.

Cassette Drive Troubleshooting

I. The cassette drive doesn't work at all.

Diagnosis	**Treatment**
Loose or defective plugs and cords	Check that they are properly inserted and not defective.

Household power supply problem	Check wall outlet.
Jammed drive	Check for foreign objects, jammed mechanism.
Dead motor	Get professional repair.

II. The cassette drive works but makes noise or operates slowly.

Diagnosis	**Treatment**
Twisted cassette tape	Check and repair.
Jammed drive	Check for foreign objects, jammed mechanism.
Failing motor	Get professional repair.

III. The cassette drive has input or output problems.

Diagnosis	**Treatment**
Bad cassette	Swap cassette.
Loose or defective cable to drive	Check cable.
Dirty tape head	Clean head.
Misalignment	Get professional repair.

8

Troubleshooting the Printer

Because the many mechanical parts of a computer printer are subject to wear and tear, printers seem to cause the most problems for personal computer owners. The most sensible solution to printer problems is proper care and routine preventive maintenance. Many of the mechanical parts of printers are exposed to the environment and are thus subject to clogging from dust, damage from spilled drinks, and other environmental hazards. A dust cover is a good investment for your printer.

Printers should be cleaned and lubricated at least twice a year. Cleaning and lubrication procedures for printers are pretty simple; see Chapter 3. You should also seriously consider a service contract for your printer, particularly if it is an expensive letter-quality printer.

Third-party maintenance companies service most popular printers and even some fairly obscure brands. They are usually glad to get your business, even if you are signing up for a service contract only on your printer.

Computer dealers generally service the printers they sell. When you buy a printer, make sure that the dealer offers a service contract, or can at least repair your printer on a per incident basis. If nobody knows how to (or is willing to) fix it, better not to buy it in the first place.

Description of Printers

Computer printers vary in shape, size, and cost. The printers most commonly used with personal computers are dot-matrix and daisy-wheel printers. Although daisy-wheel printers have been preferred in the past for letter-quality printing, several dot-matrix printers now on the market approach letter-quality printing. However, for the purposes of this book, the term "letter-quality printers" applies only to daisy-wheel printers.

Although many different kinds of printers are on the market, this book treats only the general categories of dot-matrix and letter-quality printers. Since the technology and mechanical parts of these printers are generally the same, regardless of the brand, the troubleshooting and repair techniques for solving common problems should apply to most popular brands of computer printers.

Dot-Matrix Printers

Dot-matrix printers use a system of printing mechanisms to print an array, or matrix, of dots that form characters, graphs, and other printed material (see Figure 8–1). Dot-matrix printers operate at high speeds, from 80 to 200 characters per second, and are generally less expensive than daisy-wheel (letter-quality) printers. The disadvantage of dot-matrix printers, of course, is that they generally do not print

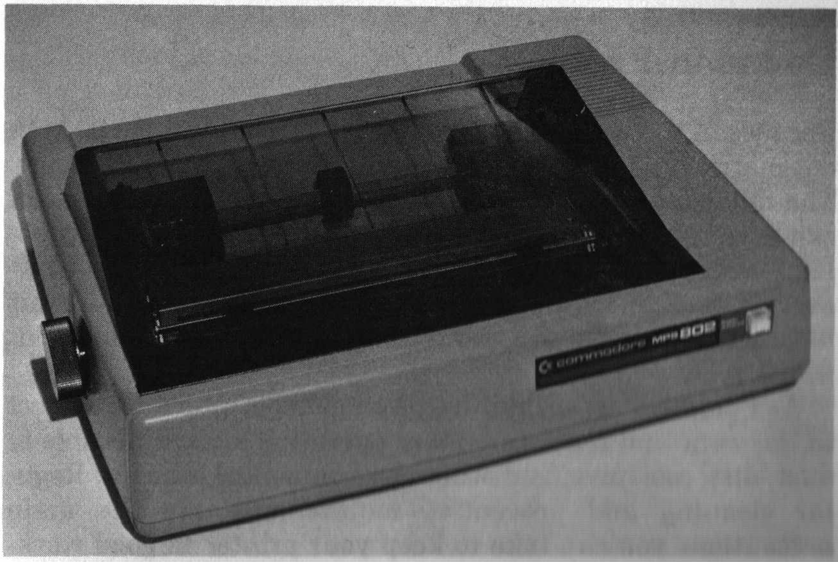


FIGURE 8–1 Commodore Dot-Matrix Printer

characters of high quality, although some are approaching letter quality.

Daisy-Wheel Printers

Daisy-wheel printers operate at slower speeds than dot-matrix printers, usually 20 to 60 characters per second. However, they generally produce a high quality of printing, which duplicates standard typewriter-quality print. For this reason, daisy-wheel printers are more expensive.

Unlike dot-matrix printers, which use print-wire technology, daisy-wheel printers operate with a daisy wheel, which has print arms for each of the characters. The daisy wheel spins at high speeds, and the hammer strikes at the desired print-character position.

Common Problems

Because of the wear and tear on their mechanical parts, both dot-matrix and letter-quality printers can be troublesome. The following section sets forth some common problems that can arise in the operation of your printer. Most of the problems affect both dot-matrix and daisy-wheel printers. However, significant differences in troubleshooting and repair techniques between the two types of printers are pointed out in the text.

As I pointed out earlier in this chapter, printers are subject to the wear and tear of frequent operation and vulnerable to dust, dirt, moisture, and other environmental hazards. Regular cleaning and preventive maintenance are the main precautions you can take to keep your printer in good working order.

In fact, many of the solutions to common problems with your printer involve cleaning or other maintenance procedures. Detailed cleaning procedures of your printer are described in Chapter 3.

I. Nothing happens when you turn the printer on.

Symptoms The printer seems dead. When you turn it on, nothing happens.

Diagnosis The problem is almost certainly related to a power supply problem, either in your home or office or in the printer's fuse.

Treatment

1. Make sure the printer's power cord is plugged in. (Most printers have their own power cords, which

plug into a wall outlet.) Also check that the power cord is not defective (loose plug, loose connections, or frayed cord).

2. Check for household or office power supply problems as well as environmental causes, such as brownouts.
3. Check the fuse on your printer. It is generally located near the plug for the power cord and can be easily removed from its holder. If the fuse is burned out, replace it with an exact duplicate. Do not use just any fuse you happen to have on hand; you could seriously damage your equipment if you use the wrong kind of fuse. If the printer still doesn't work, or if it works for a short time and the fuse burns out again, then take the printer in for repair.

II. The printer has power but doesn't operate or perform the self-test.

Symptoms The printer clearly has power but is not functioning at all. The self-test does not activate, and none of the alarm lights on the printer panel are lit. (If one of the alarm lights is lit, you must correct the indicated problem before the printer will work correctly.)

Diagnosis The preliminary diagnosis is a power supply problem; however, it may also be a more serious problem with the printer's control circuitry.

Treatment

1. Make sure that the power plug is securely fastened and that there are no apparent household power supply or environmental problems. If the printer has power but is not functioning, then the problem may have been a temporary power transient. Try turning off the printer and restarting it.

2. If the household power supply checks out, there is probably a failure in the printer's own control circuit, which handles the data sent from the computer. With this diagnosis in hand, take your printer in for repair.

III. The printer performs the self-test but doesn't print on command.

Symptoms The printer performs the self-test normally, but it does not respond to print commands. None of the alarm lights are lit, and the printer is on-line. (If an alarm light is on, then correct the indicated problem.)

Diagnosis There are a number of reasons why your printer will not print on command. They include a mechanical or electronic problem with the printer, a problem in the interface between the computer and the printer, and a local (household or office) power supply problem.

Treatment

1. Check that every mechanical part is in working order. For example, is the ribbon properly placed? Is the carriage in its proper position? Many printers automatically stop if one or more of these components are not in their proper places.
2. Check that the cable between the computer and the printer is firmly connected and not defective. Check that the connectors in the printer and system unit are not loose to the touch.
3. Check the local power supply to make sure that the printer is getting enough power, particularly if you are having problems with other parts of your computer system. Check for obvious signs of power prob-

lems, such as dimming lights, or have an electrician check the voltage.

4. If your local power supply checks out, you probably have an interface problem, which is frequently the cause of printer difficulties. Interface problems include improper baud rate settings, improper internal DIP switch settings, software bugs, or bad interface circuitry in the console. The first thing to check is that the baud rates and other interface settings on the computer match those on the printer. Also double-check any other printer installation procedures that may be causing interface problems. These procedures should be in your printer manual.

5. Check your software for interface problems, since these might be locking up your printer. Try using another software program; if the printer works, you have a software problem.

6. Most remaining interface problems occur in the interface circuits of the console itself. If you have another printer or can borrow a friend's, test the other printer to determine whether the problem is in the printer or in the computer. Or take your system to a dealer or repair shop and have it tested. Repairs of hardware interface problems are best left to professionals.

IV. The printer prints junk.

Symptoms The printer functions smoothly, except that it prints nothing but nonsense. Or the printer works fine, but then loses characters, ignores spacing, or otherwise fouls up.

Diagnosis This is either an interface problem or a problem with the computer circuits.

Treatment

1. Check that the printer baud rate and other interface settings match those of the computer. Refer to your manuals for this information.
2. Check your software by removing the program you are using and replacing it with a different one. If the printer works with the new program, you have a software problem.
3. You may have a problem with circuits in the computer. If you have another printer or can borrow one from a friend, test it on your computer. If the new printer doesn't work, you have a system problem and should take your console in for repair. If the new printer works, then you probably have a problem in the circuitry of your own printer and should take it in for repair.

V. The printer makes random errors.

Symptoms From time to time, the printer produces incorrect characters and spacing or makes other errors.

Diagnosis This is a fairly subtle problem. Causes include software bugs, mechanical or electronic problems in the printer, local power supply or environmental problems, and problems with one of the other components of the system. The best approach is to eliminate each possible cause in a step-by-step fashion.

Treatment

1. Check the software by replacing the program you are using with another program. If this program prints without errors, then you may have stumbled on some bugs in the original software program. Call your dealer or the software manufacturer.

2. Check the cables between the printer and the system. Are they firmly in place? Are they in good working order? (Are the connectors good? Are the cords broken or frayed?) Try removing and reconnecting the cable just in case.
3. Remove the top of the printer and examine it. Are there obvious problems, such as a buildup of dust or dirt, or foreign objects gumming up the works? If so, give the printer a thorough cleaning as described in Chapter 3. (This cleaning should be done once or twice a year in any case.) Do the mechanical elements of the system operate freely, or do they make grinding or other ominous sounds? If you suspect mechanical problems, take the printer in for repair.
4. Swap printers. The printer may not be the cause, but rather the computer or the disk drives. If, after substituting another printer, you have the same problems, begin to suspect problems with the disk drive or console. (See Chapters 5 and 7 for console and disk drive problems.)
5. If you determine that the problem is indeed in the printer, and there are no obvious mechanical or power supply problems, then the printer circuitry might be failing. In that case, take the printer to a professional repair person with your diagnosis in hand.

VI. The printer functions smoothly, then suddenly stops.

Symptoms The printer simply stops in the middle of a printing operation for no apparent reason.

Diagnosis This malfunction could be the result of a software bug, a poor cable or connection, a power supply or environmental problem, or an interface problem.

Treatment

1. Check first for an alarm light or error message. Also make sure that the ribbon, paper, carriage, or printer cover has not slipped out of place, causing the printer to shut off.
2. Check the software to make sure you haven't encountered a bug. Replace the program you are using with another program to see if the printer has the same problems.
3. Check the interface with the console. If your printer has a self-test print function, try printing the self-test. If the self-test is normal, then you probably have an interface problem. First check that the cable to the console is properly in place and not defective. Also check that the connectors on the console and printer are not loose. Make sure also that all the interface settings of the printer match those of the console (see your manuals for this information). Another way to determine an interface problem is to substitute another printer. If the new printer behaves similarly, you probably have an interface problem or a problem with another element of the computer system.
4. If you are fairly certain that the problem is in the printer itself, and none of these measures seem to solve the problem, the printer circuitry may be failing. Take it to a repair person with your diagnosis in hand.

VII. The print carriage doesn't move at all.

Symptoms The print carriage seems frozen in place and does not move smoothly, even if you try to move it by hand.

Diagnosis This is probably a mechanical problem due to a loose part, a foreign object jamming the print carriage, or a malfunction of the printer drive cable or pulley.

Treatment

1. Remove the printer cover and inspect the print carriage. If a foreign object or buildup of dust is blocking the carriage, remove it and clean the carriage area. If no foreign object seems to be jamming the carriage, check for loose screws or other parts. Also check whether the carriage has slipped off the cable mechanism. Many carriages have wheels that can slip off their supports.
2. If there are no obvious problems with the carriage mechanism, then you may have a problem with the motor or circuits that drive the carriage. Take this problem to a professional repair person.

VIII. The printer operates but doesn't print.

Symptoms The printer seems to function correctly. It performs the self-test successfully, and all mechanical parts seem to be operating correctly. The only problem is that it either does not perform any print strikes or no printed material appears on the page.

Diagnosis These are generally mechanical problems caused by a jammed print head or ribbon. But the cause might also be power supply or control circuit problems.

Treatment

1. If the print head is striking the paper but nothing appears on the page, then you can assume some-

thing is wrong with the ribbon. Check that the ribbon and ribbon cartridge are securely in place. Also check that the ribbon is advancing correctly and is not jammed in the cartridge. If it is jammed, take out the cartridge and try to advance the ribbon by hand. If this doesn't work, replace the ribbon cartridge. You should also check the ribbon advancing apparatus to make sure that a foreign object or loose part is not jamming the mechanism.

2. If the print head is not striking the paper at all, then the head is probably at fault. Check that the print head is not jammed by some foreign object or clogged with dust. If the print head is dirty, clean it. (See Chapter 3 for instructions on cleaning your print head.)
3. If the print head mechanism is broken or poorly aligned, then you should send it to the repair shop. Problems in the printer circuitry might be the cause; these require professional attention also.

IX. The printer is overheating.

Symptoms The printer is hot to the touch or begins operating more slowly or erratically.

Diagnosis Overheating can be due to a jammed printer head, a malfunctioning motor, or a bad printer circuit.

Treatment

1. Turn the printer off. Whenever any element of your system begins to overheat, turn it off immediately and let it cool off.
2. Check for obvious causes. Have you left your printer in the direct sunlight or next to some heat source? If so, move it away.

3. Is the print head jamming? This can cause the printer to overheat. Open the printer cover and see if the print head is jammed by some foreign object or loose part.

4. There may also be a problem with the printer circuits or the printer's temperature sensor. If you suspect these problems, take the printer in for repair.

5. If your printer begins to emit *smoke,* for any reason, immediately turn it off. If there is no obvious cause, such as a jammed print head, take the printer in for repairs.

X. The printing is uneven.

Symptoms This symptom takes a number of forms, ranging from unevenly printed individual letters to poorly printed parts of the page (left or right, top or bottom).

Diagnosis The causes range from a worn ribbon to a misaligned printer platen.

Treatment

1. If the letters are uniformly worn or faded, then your ribbon is probably worn and should be replaced. However, if your printer has a setting that determines the darkness or lightness of the output, check that setting, too.

2. On a daisy-wheel printer, this problem may be caused by a dirty print head. To clean the print head, just scrape away the ink, dust, or dirt clogging the individual letters. You can do this with a needle or similar instrument, provided you are careful not to chip away at the letter itself. Then clean the daisy wheel with a clean rag dampened with alochol.

3. If some of the letters are printed unevenly, or if lines fade in and out, the culprit might be a misaligned printer platen or a defective or misaligned printer hammer or ball. Although you may want to send your printer to the repair shop for alignment of the platen or the print head, it is fairly simple to make these adjustments on most printers. (See the section "Printer Adjustments," below.)

XI. Characters or parts of characters are missing.

Symptoms The symptoms vary, depending on whether you have a dot-matrix or a daisy-wheel printer. On dot-matrix printers, the characters may have missing dots, typically along one or more of the print wires. On daisy-wheel printers, the letters may be cut off at the top or bottom, or certain letters may not be completely printed.

Diagnosis On a dot-matrix printer, the problems may be caused either by a defective or dirty print head or by the printer's control circuitry. On daisy-wheel printers, the problem is due to a dirty print hammer, worn ribbon, or bad control circuitry.

Treatment

1. Check first that the print ribbon is properly placed and not worn out. If it is not in its proper place, remove it and reinsert carefully. If it is worn out or faded, replace it.
2. Clean the print head or hammer. Remove any dust or other foreign objects that could interfere with the striking of the print head. If you have a daisy-wheel printer, remove the daisy wheel and clean the letters carefully with a needle or similar instrument. Then

wipe the daisy-wheel with a clean cloth dampened with alcohol.

3. If none of this works, then you may have a problem with the ribbon mechanism. This problem can have a variety of sources, including a faulty solenoid or motor. If you suspect this kind of problem, take your printer in for professional repair.

XII. The paper jams or doesn't feed properly.

Symptoms A number of paper problems can occur when you are printing. The paper can jam or shred during printing, or the printer may not advance properly, making the line spacing incorrect. Sometimes the printer prints over existing lines.

Diagnosis Most of the time, paper problems are caused by improper loading or the wrong type of paper. Depending on the printer's feeding mechanism, various other problems may arise during printing.

Treatment

1. Check that the paper is correctly loaded into the feeding mechanism. Is it straight and centered so that it doesn't rub against the guides on the side? If the printer has a tractor-feed mechanism, is the paper lined up correctly in the tractor pins?
2. If the paper is not advancing properly, you may have loaded it incorrectly into the tractor mechanism. Or if the printer has a friction-feed mechanism (like a standard typewriter mechanism), the levers must be in the closed position to permit the paper to advance.
3. Make sure that no scraps of paper or other foreign objects in the printer or tractor feed are clogging the

mechanism. If so, clean the printer and/or tractor feed. (See Chapter 3 for detailed cleaning procedures.)

4. If you still have problems, you may have a defective part. Take the printer to a professional repair person.

Printer Adjustments

Although a wide variety of printers are on the market, they all operate in essentially the same ways, depending, of course, on whether they are dot-matrix or daisy-wheel printers.

Cleaning and lubricating printers, described in detail in Chapter 3, is the most important factor in preventive maintenance. Because printers have many mechanical parts and are exposed to dust and spills, they must be kept clean and well lubricated.

Your printer should have a service manual that describes procedures for cleaning and lubricating. Follow those procedures carefully, especially when it comes to choosing lubricants. If the service manual recommends a certain oil or grease, use only that kind. Don't take chances by using the wrong product.

Although most mechanical repairs of printers are best left to professionals, you can make some adjustments yourself. Nevertheless, getting a service contract on your printer is a wise and usually modest investment, even if no other part of your computer system is covered by a service agreement.

The following sections describe adjustments to the platen and the print head. You will need to make these adjustments if the characters are not printing normally. For example, if the left side of a line of characters is darker than the right side (or vice versa), then your platen probably needs adjusting. Or if individual characters are lighter on the top than the bottom (or vice versa), then your platen may be too high (or too low).

The print head may also be to blame, particularly if a letter is darker on one side than the other. This problem might be due to an off-center print head that needs adjusting.

Platen Adjustment

1. Remove the cover from the printer.
2. At each end of the printer are two adjusting screws that move the platen up and down or back and forth. If your problem is lightness on one side, then move that side slightly forward. If your problem is lightness on the top or bottom of the letters, move the platen up or down slightly.
3. Tighten the screws, replace the cover, and test the printer.

Print Head Adjustments of Daisy-Wheel Printers

1. Remove the printer cover.
2. Turn the screws on the hammer assembly to adjust where the hammer strikes the print wheel. If the hammer is slightly off-center, one side of a letter will be darker than the other.
3. You may also be able to change the position of the home character on the daisy wheel to recenter the hammer. (Check your printer service manual for this procedure.)

Print Head Adjustment of Dot-Matrix Printers

1. Remove printer cover.
2. Before adjusting the print head, try to adjust the platen to see if that solves the problem.
3. If not, you can adjust the print head by loosening the adjusting screws on the print head mechanism. Make sure, however, that you maintain the proper space between the print head and the platen, since this is especially important to the operation of dot-matrix printers.

Printer Troubleshooting Chart

I. Nothing happens when you turn the printer on.

Diagnosis	Treatment
Loose or defective switches, cords, or plugs	Check that all switches are on, plugs are inserted, and cords are intact.
Bad printer fuse	Check and replace fuse.

II. The printer has power but doesn't operate or perform the self-test.

Diagnosis	Treatment
Loose or defective switches, cords, or plugs	Check that all switches are on, plugs are inserted, and cords are intact.
Console problem	Disconnect printer and test system.

III. The printer performs the self-test but doesn't print on command.

Diagnosis	Treatment
Ribbon or paper problem	Check ribbon and paper.
Carriage or other mechanical problem	Check for proper function, placement.
Defective or loose cable	Check cable.
Interface problem	Check baud rate and other interface settings.
Software bugs	Swap software.

IV. The printer prints junk.

Diagnosis	Treatment
Interface problem	Check baud rate and other interface settings.
Software bugs	Swap software.
Console problem	Remove printer and check system.

V. The printer makes random errors.

Diagnosis	Treatment
Defective or loose cable	Check cable.
Software bugs	Swap software.
Dirty print heads	Clean printer.
Household power supply problem	Check for transients.
Console or drive problem	Swap printer; if problems remain, then other component is at fault.

VI. The printer functions smoothly, then suddenly stops.

Diagnosis	Treatment
Defective or loose cables	Check for proper insertion.
Printer error	Check for alarm light or error message.

VI. *(Continued)*

Diagnosis	Treatment
Software bugs	Swap and check for bugs.
Interface problem	Check baud rate and other interface settings.
Household power supply problem	Check for transients.
Console or drive problem	Swap printer; if problems remain, then other component is at fault.

VII. The print carriage doesn't move at all.

Diagnosis	Treatment
Jammed carriage	Check for foreign object, loose parts.
Defective or loose cable or cord	Check for proper insertion.
Interface problem	Check baud rate and other interface settings.
Console problem	Swap printer, check.
Defective carriage	Replace carriage.

VIII. The printer operates but doesn't print.

Diagnosis	Treatment
Faulty ribbon	Check ribbon for placement and advance.
Print head problem	Check that print head is operating; clean, adjust, or replace.

IX. The printer is overheating.

Diagnosis	Treatment
Blocked ventilation	Check outlet.
Jammed print head	Clean or replace.

Malfunctioning printer circuits	Get professional repair.

X. The printing is uneven.

Diagnosis	**Treatment**
Worn ribbon	Replace ribbon.
Dirty print head	Clean print head.
Misaligned platen	Align printer platen.

XI. Characters or parts of characters are missing.

Diagnosis	**Treatment**
Ribbon out of place	Check and adjust.
Dirty print head or hammer	Clean.
Faulty ribbon mechanism	Replace.

XII. The paper jams or doesn't feed properly.

Diagnosis	**Treatment**
Paper problem	Check for correct loading; if tractor feed, turn off friction feed.
Jammed printer	Check for dirt or foreign objects; if OK, get professional repair.

9

Commodore Warranties and Repair Plans

Much controversy surrounds warranties of personal computers. Many critics of the current warranty offerings argue that it is virtually impossible to give a microcomputer system a fair trial in the standard ninety-day warranty period. Most computer systems, they assert, do not develop problems until well into the first year of operation.

By and large, personal computer warranties are shorter than those for other expensive appliances, even some in the electronics field. In some cases, these limited warranties have fostered customer dissatisfaction, cynicism, and even fraud.

Although most computer owners don't consider the implications of the limited ninety-day warranties when deciding which personal computer to buy, there are enough horror stories of customers whose computers broke down after the warranty expired to forment change in the industry.

Lately, personal computer manufacturers have begun to respond to the criticism by offering longer warranties and extended warranty plans. Although Commodore still offers only a ninety-day warranty on its products, it also offers a comprehensive post-warranty program of factory repair.

This chapter explains the Commodore warranty and your rights under it (as well as under warranties in general). It also examines Commodore's repair program and helps you decide whether the program is right for you.

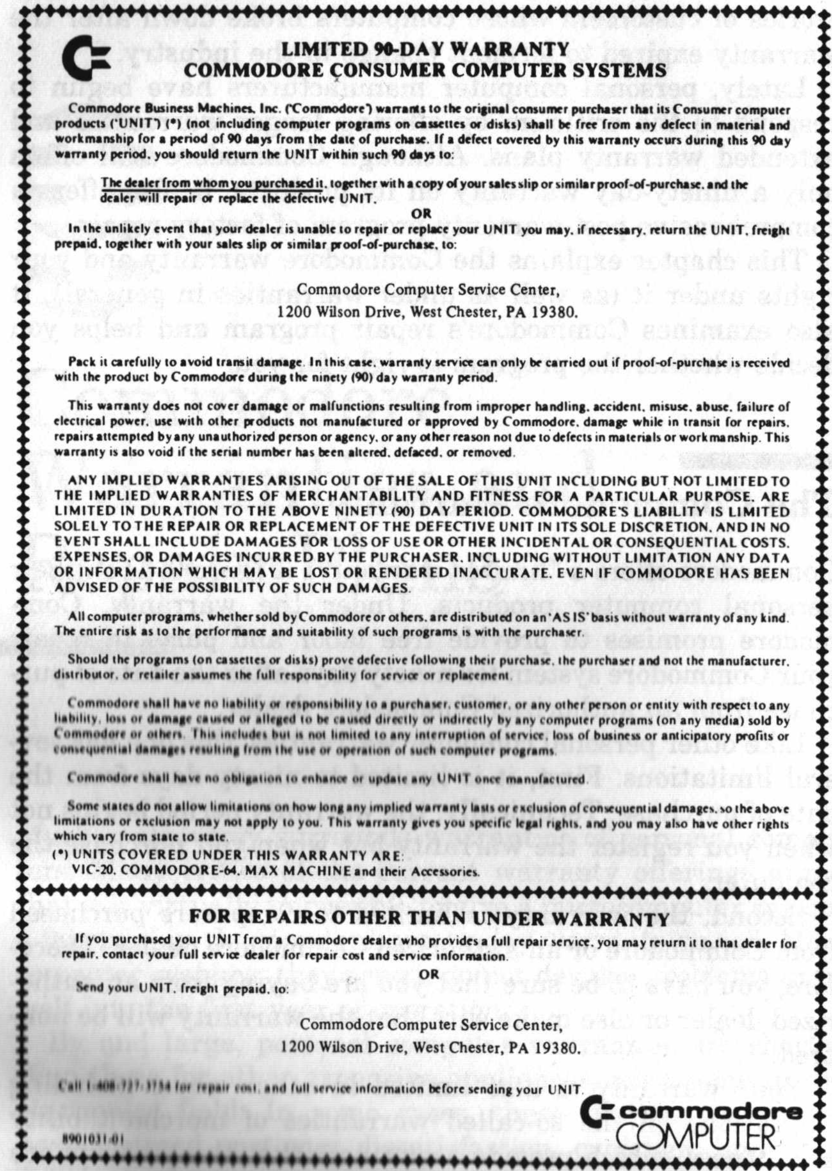
The Commodore Warranty

Commodore offers a "limited warranty" (Figure 9–1) on their personal computer products. Under the warranty, Commodore promises to provide free labor and parts to repair your Commodore system for ninety days after the date of purchase from an authorized Commodore dealer.

Like other personal computer warranties, this one has several limitations. First, it is limited to ninety days from the date of purchase. Technically, the warranty period begins not when you register the warranty but when you purchase the computer.

Second, the warranty is limited to computers purchased from Commodore or an authorized Commodore dealer. Therefore, you have to be sure that you are buying from an authorized dealer or else make sure that the warranty will be honored.

Your warranty is also limited in other ways, including limitations on the so-called warranties of merchantability and fitness, which provide assurances that the products are suitable for their intended purpose. This limitation, which is contained in most personal computer warranties, is like saying that if the steering wheel of your new car falls off, causing the car to be destroyed, you may not hold the manufac-



LIMITED 90-DAY WARRANTY
COMMODORE CONSUMER COMPUTER SYSTEMS

Commodore Business Machines, Inc. ('Commodore') warrants to the original consumer purchaser that its Consumer computer products ('UNIT') (*) (not including computer programs on cassettes or disks) shall be free from any defect in material and workmanship for a period of 90 days from the date of purchase. If a defect covered by this warranty occurs during this 90 day warranty period, you should return the UNIT within such 90 days to:

The dealer from whom you purchased it, together with a copy of your sales slip or similar proof-of-purchase, and the dealer will repair or replace the defective UNIT.

OR

In the unlikely event that your dealer is unable to repair or replace your UNIT you may, if necessary, return the UNIT, freight prepaid, together with your sales slip or similar proof-of-purchase, to:

Commodore Computer Service Center,
1200 Wilson Drive, West Chester, PA 19380.

Pack it carefully to avoid transit damage. In this case, warranty service can only be carried out if proof-of-purchase is received with the product by Commodore during the ninety (90) day warranty period.

This warranty does not cover damage or malfunctions resulting from improper handling, accident, misuse, abuse, failure of electrical power, use with other products not manufactured or approved by Commodore, damage while in transit for repairs, repairs attempted by any unauthorized person or agency, or any other reason not due to defects in materials or workmanship. This warranty is also void if the serial number has been altered, defaced, or removed.

ANY IMPLIED WARRANTIES ARISING OUT OF THE SALE OF THIS UNIT INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE ABOVE NINETY (90) DAY PERIOD. COMMODORE'S LIABILITY IS LIMITED SOLELY TO THE REPAIR OR REPLACEMENT OF THE DEFECTIVE UNIT IN ITS SOLE DISCRETION, AND IN NO EVENT SHALL INCLUDE DAMAGES FOR LOSS OF USE OR OTHER INCIDENTAL OR CONSEQUENTIAL COSTS, EXPENSES, OR DAMAGES INCURRED BY THE PURCHASER, INCLUDING WITHOUT LIMITATION ANY DATA OR INFORMATION WHICH MAY BE LOST OR RENDERED INACCURATE, EVEN IF COMMODORE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

All computer programs, whether sold by Commodore or others, are distributed on an 'AS IS' basis without warranty of any kind. The entire risk as to the performance and suitability of such programs is with the purchaser.

Should the programs (on cassettes or disks) prove defective following their purchase, the purchaser and not the manufacturer, distributor, or retailer assumes the full responsibility for service or replacement.

Commodore shall have no liability or responsibility to a purchaser, customer, or any other person or entity with respect to any liability, loss or damage caused or alleged to be caused directly or indirectly by any computer programs (on any media) sold by Commodore or others. This includes but is not limited to any interruption of service, loss of business or anticipatory profits or consequential damages resulting from the use or operation of such computer programs.

Commodore shall have no obligation to enhance or update any UNIT once manufactured.

Some states do not allow limitations on how long any implied warranty lasts or exclusion of consequential damages, so the above limitations or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

(*) UNITS COVERED UNDER THIS WARRANTY ARE:
VIC-20, COMMODORE-64, MAX MACHINE and their Accessories.

FOR REPAIRS OTHER THAN UNDER WARRANTY

If you purchased your UNIT from a Commodore dealer who provides a full repair service, you may return it to that dealer for repair, contact your full service dealer for repair cost and service information.

OR

Send your UNIT, freight prepaid, to:

Commodore Computer Service Center,
1200 Wilson Drive, West Chester, PA 19380.

Call 1-408-727-3734 for repair cost, and full service information before sending your UNIT.

commodore
COMPUTER

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FIGURE 9–1 Commodore Warranty

turer liable for damage to the car beyond a ninety-day warranty period. Some states simply don't permit this kind of limitation.

Commodore also includes a limitation in its warranty on incidental or consequential damages because of failure of their computers to operate properly. Although this limitation is less dubious, it is also an attempt by the company to hold their liability to the minimum.

Repairs under the Commodore Warranty

Under the warranty, Commodore promises to repair your system and restore it to good working order with no charge for labor or parts up to ninety days after the date of purchase. The warranty also provides that Commodore has the choice of either repairing your computer or some component of the system, or simply swapping components. In the event that parts are swapped, the replaced parts become the property of Commodore.

On-Site versus Carry-in Repairs

The Commodore warranty provides for only carry-in service on Commodore products. This means that the customer must bring the computer into a Commodore dealer for repair.

Most Commodore dealers will not send repair staff to your home or office to repair your system under the standard warranty. It may be possible, however, to get on-site repair (at your home or office) through a service contract, which is discussed later in this chapter.

Length of Repair Time

Although Commodore makes no promises about length of repair time, forty-eight hours or less is considered the average repair time for carry-in service. For on-site service, repair or exchange is generally done the same day. A two-day turnaround time for carry-in service is a pretty good record in the personal computer industry.

Routine and Preventive Maintenance

Generally, you can't bring your Commodore system into your dealer for routine or preventive maintenance. However, if your system has some specific problem, then the repair staff will give it a routine cleaning. (But be sure to remind them to do this!)

Help Lines

Commodore has an extensive system of customer service and support "help lines." These are toll-free numbers that refer you to a dealer in your area or answer specific questions, particularly in the area of software. These toll-free lines can be an important resource when you have problems. Don't hesitate to use them.

Software Support

Software support can be a big help, especially when you're just breaking in your system or trying out new software. As long as you're entitled to this help under the warranty, it's a good idea to call Commodore even if your question seems simple, or you simply don't understand something in the manual. It's often easier to talk to someone about the problem than to figure out a manual.

Exclusions under the Warranty

Commodore has a number of important exclusions under its warranty and service agreements, including repairs of damage resulting from neglect, misuse, accident, improper operating conditions, and unauthorized repair. These fairly broad exclusions are discussed in detail later in this chapter.

Warranty Extensions and Service Plans

Although Commodore itself has no provision for warranty extensions or service plans, many Commodore dealers offer programs for extending the warranty for an additional year of free labor and parts. Although the initial Commodore warranty period covers only carry-in service, the dealer warranty extension or service plan may include a number of options, including on-site repair or exchange.

If you intend to purchase a service contract for your Commodore system, it's a good idea to buy it when you purchase the system or while your warranty is still in force. One important reason to consider a full service agreement at the time of purchase is that you may be able to negotiate for a service contract. You might, for example, ask if your dealer is willing to offer you the service plan or warranty extension as part of the purchase price or at reduced rates.

Commodore Repair Plans

Although Commodore does not offer comprehensive service plans for its products, it does provide for factory repair of Commodore products under a fixed-rate schedule.

Under the factory service plan, Commodore will repair or replace most of the system elements, including the computer console, the disk drive, the monitor, and the printer, for fixed charges. The customer must pay for shipping one way.

Table 9–1 shows the Commodore fee schedule for some of its factory repairs.

On-Site Service Contracts

Many Commodore dealers also offer on-site service contracts for their personal computer customers. Under these con-

Table 9–1 Commodore Factory Repair Prices

Computer Console	$55
Disk Drive	85
Video Monitor	95
Dot-Matrix Printer	75

Note: Customer responsible for one-way shipping costs. Prices are dealer quoted 1985 prices.

tracts, the dealer's service technicians will come to your home or office to repair or exchange the failing parts of your system.

Prices for the on-site service rane from 10 percent to 15 percent of the price of the system annually. The same exclusions for accident, misuse, neglect, and unauthorized repair apply.

Loanout Program

Commodore dealers frequently offer a loanout program under which you can borrow a system from the dealer while yours is being repaired. Annual charges for carry-in loaner service plans range from 10 percent to 15 percent of the system price, while on-site loaner plans are usually at least 15 percent of the system price. These loaner programs are particularly useful if you rely on your computer system daily.

Limitations on Warranties and Service Agreements

There are a number of limitations on Commodore's warranty (and on most dealers' service agreements). The following sections survey some limitations to watch for.

Proper Environment Under the Commodore warranty and most service agreements, you must provide a suitable environment for your personal computer system. This may be interpreted to include an environment with proper temperature and humidity, protection against dust and spills, and proper power protection in the form of a surge protector.

Although Commodore dealers would probably not deny service to a customer whose system is damaged by some environmental factor, most service agreements give them the right to charge for these repairs, which they might exercise in particularly egregious cases.

Accident, Misuse, Neglect ... Commodore does not cover, under its warranty, damage caused by neglect, misuse, accident, use of the machines for purposes other than for which designed, improper alterations of attachments, non-Commodore parts, or unauthorized repairs.

This comprehensive list of exclusions, if interpreted literally, would probably exclude 75 percent of repairs that would otherwise be eligible. Although Commodore does not deny repair or charge extra for repairs made necessary by common instances of damage, they are likely to deny repair of damage from unauthorized service on the system, owner tampering, or use of non-Commodore components.

Unauthorized Repair Commodore's warranty and most dealer service plans do not cover damage caused by unauthorized repair, including repair by professional service people and by computer owners. Depending on the repair that you or some unauthorized technician attempted, you could end up paying more by trying to repair the system yourself or hiring someone who is not competent to do it.

The watchwords, of course, are common sense and caution. Most of the simple repairs described in this book, including cleaning and other routine procedures, do not pose much risk of damaging your system. Even if they did, you could probably get the damage fixed under your warranty or service contract.

If, however, you begin complicated repairs, such as chip replacement, without proper precautions and damage the system as a result, you may have trouble explaining the damage to your Commodore dealer. This is particularly true of damage caused by hooking up complicated, incompatible hardware to Commodore machines.

Non-Commodore Hardware and Software Commodore generally does not service non-Commodore products under its warranty. In addition, it will not exchange or service a system that has non-Commodore parts, options, attachments, or alterations. It is the responsibility of the customer to remove these non-Commodore items before the system is serviced.

Commodore dealers are generally more flexible than Commodore itself about so-called mixed systems, particularly if they sold you the non-Commodore products in the first place. However, if they do not carry or support the product, then they may refuse to service it.

Routine or Preventive Maintenance Under the Commodore warranty and most dealer service agreements, a customer is not entitled to routine or preventive maintenance of the computer system. However, if a problem develops, most dealers will perform maintenance as part of the repair.

This, of course, creates a problem for conscientious personal computer owners who want to keep their machines in good working order but who are not interested in doing complex or even routine maintenance chores themselves. The only solution for this kind of owner is to take the machine in for repair at the first hint of trouble.

In any case, under most dealer service agreements, the dealer will perform "remedial" maintenance and repair, including replacement of parts deemed necessary by the dealer, when you bring in a failing machine.

Software and Peripheral Support Commodore provides extensive support for Commodore peripherals, including modems, expansion units, monitors, and a wide variety of other Commodore-made units. Of course, Commodore does not service non-Commodore peripherals.

Commodore also does not provide extended support for its software beyond the warranty provisions, largely because of the complexity of computer software and the difficulty and tremendous expense of providing comprehensive software service. And, with the addition of the huge volume of Commodore-compatible software, the task of providing support for all software used on Commodore personal computers is virtually impossible.

Although Commodore has not tried to offer extensive software support, there is growing pressure on Commodore and other manufacturers to increase support of their software products.

With little attention paid by either hardware manufacturers or software vendors to the problem of software support, a few independent software service providers have cropped up around the country. Despite the complexities and expense of providing software support, this area of the microcomputer maintenance industry will see the biggest growth in the near future.

10

Getting Help from Your Computer Dealer

When something goes wrong with your Commodore 64 computer, the first place you will probably go for help is to the dealer who sold you the computer system. For the most part, your dealer's store is a good place to start when you need help. However, successful resolution of your problem may depend on its seriousness, the training and efficiency of your dealer's service staff, and a host of other factors.

This chapter discusses dealers as a resource for maintenance, repair, and service. It examines computer dealers in general: Who are they? What service and support can you expect from them? The chapter also looks at Commodore-authorized dealers and the training and support they get from Commodore. In addition, it discusses service and support available from independent computer dealers and retail chains. Finally, this chapter examines the ins and outs of dealer service, comparing prices, length of repair times, and other aspects of dealer service.

The purpose of this chapter on dealer service is to provide a realistic look at exactly what help you can (and can't) expect to get from your computer dealer. Many personal computer owners proceed on the naive assumption that the computer dealer is ready, willing, and able to help with whatever problem may arise with your computer. Unfortunately, this impression is often created by salespeople who, though eager to sell you a system, can be vague about the details of support and service after the sale is made.

What Your Dealer Can (and Can't) Do

In the early days of the personal computer market, dealers were often available to answer question and hold their customers' hands through various problems in the installation and operation of their Commodore 64 systems. Times have changed. With millions of Commodore 64 computer systems now installed in homes and offices, the resources of authorized Commodore 64 dealers (and other computer dealers) are now spread very thin in terms of after-sale service and support.

Of course, dealers want happy customers, but the volume of service problems and questions is often overwhelming. And these problems will be exacerbated as more personal computers develop hardware problems with age. As Commodore and other manufacturers rush to provide adequate service networks, the dealers are caught in the middle.

Most people buy their personal computers with the assumption that nothing serious is going to go wrong. This assumption is also bolstered by salespeople who don't see many day-to-day repair problems and are secure in the industry's assurances that personal computers are generally trouble-free. In any case, most potential customers don't ask much about dealer service and support. And if they do, they are usually satisfied with general answers, such as, "Just call us up if there's a problem."

What dealers don't discuss in detail is the average cost of parts and labor per repair, length of repairs, training of their service personnel, problems with non-Commodore hardware or software, and similar issues.

In short, computer dealers are primarily in the business of selling computers, not servicing them. Although there seems to be a countertrend toward more customer service and support, most dealers simply do not have the resources to cope with maintenance and repair of all the systems they sell.

The Role of Commodore

Like other computer manufacturers, Commodore has always followed the policy of using its authorized dealers as the first line of support for their customers. This made sense, after all, since the local dealers knew their customers best and were in the best position to answer their questions and solve their problems.

However, the enormous boom in personal computer sales and the emergence of Commodore as a leader in the field has meant that dealers are swamped with customer requests for service and support. Also, the field has become more complex —new hardware and software are constantly developed. Today, dealers are less able to stay on top of changes and in turn to meet the needs of their customers adequately.

Although Commodore still relies on its dealers to provide primary customer support and service, it has expanded its service backup somewhat. For example, it now operates a national service program, which provides for exchange or repair of defective elements for a standard fee. In the future, Commodore will probably expand its service offerings and play a greater role in service and support.

The Role of Third-Party Maintenance Companies

Third-party maintenance firms specialize in the maintenance and repair of computers, ranging from huge mainframes to ordinary personal computers. Until recently, many of these third-party firms stayed away from the personal computer maintenance and repair market because they considered it "small potatoes."

However, with the personal computer revolution came a base of nearly four million personal computers installed in homes and offices around the country. With dealers and manufacturers unable to handle the enormous demand for service and support of their computers, these third-party firms stepped in to fill the vacuum.

In fact, many of these companies were invited in by large computer manufacturers and their dealers, who were unable or unwilling to provide extensive support to their own customers. The only sensible solution was to call in the third-party companies, who specialized in maintenance and repair and also had the staff, inventory, and expertise to handle all the personal computers out there.

The largest national provider of personal computer repair and maintenance services is Sorbus Service, although many local or regional companies repair personal computers. Other national third-party maintenance companies have familiar names, such as TRW, Western Union, and RCA. Even Xerox, which also manufactures personal computers, has an extensive third-party service organization.

At the present time, most of the large, national third-party service companies do not provide service and support for Commodore products. For the most part, these companies are concentrating on the more expensive personal computers, such as IBMs and Apples. However, as they become more involved in providing maintenance and service to consumers, they will undoutedly expand their service offerings to include Commodore and other lower-cost models.

In addition, a large number of smaller, independent service companies provide service for Commodore products. These range from regional service organizations to tiny, one-person repair shops. For Commodore owners, these independent service companies provide a valuable alternative to either dealer or Commodore service plans.

Who Is Your Dealer?

Dealers come in all sizes and shapes, from large national retail chains to people who sell computers part-time out of their living rooms. Each dealer has strengths and weaknesses: Some charge higher prices for the Commodore 64 system but provide more support; others discount their prices but offer very little help after the sale is made.

The key to choosing a dealer is to figure out what your needs will be after you've bought the system and whether a dealer can meet those needs. Even after you've purchased the system, it's a good idea to know when you should go to your dealer for help and when it's a plain waste of time to call.

Office Equipment Dealers

Computers have traditionally been sold through independent sales organizations, which generally sell complete systems, often at a higher price, but offer a lot of backup and support. These companies work with you to tailor hardware and software to your particular needs and are there to help if problems arise, not only in terms of repair and maintenance but also of system configuration and changing software requirements.

These independent sales companies are geared largely to business users and are probably a good choice if you have a small business that makes special demands of its personal computer system. However, most Commodore 64 users don't need this level of advice and support.

Computer Stores

Stores that specialize in selling personal computers to individuals and small businesses have sprung up around the country since the personal computer revolution hit in the early 1980s. Virtually nonexistent ten years ago, they now account for nearly 40 percent of the total retail sales of personal computers.

Computer stores can be anything from an outlet of a national chain like Computerland to a single store. By and large, these stores charge list prices for Commodore 64 and other personal computer systems and provide a fairly broad range of maintenance and support services.

However, computer stores, like other retail outlets, are primarily in the business of selling computers rather than supporting and servicing them. For this reason, many have somewhat thin service resources, which can lead to delays, higher repair bills, and a greater likelihood of mistakes.

Discount Stores

Discount stores may sell only computers, or they may sell other electronic equipment and appliances as well. These stores may be part of larger discount chains, or they may simply be independent discount outlets.

Virtually the only purpose of these discount stores is to sell merchandise. They are rarely set up to provide the service and support that most users of personal computers need. However, many Commodore 64 systems are sold through these outlets to users who don't need extensive service and support.

Department Stores and Other Major Retailers

Major department stores such as Sears have begun selling personal computers, in many cases lower-priced models like the Commodore 64. These department stores do not offer much in the way of service and support, although Sears and other major chains have begun to offer some maintenance and other services.

Electronics/Specialty Stores

Electronics, stereo, video, and other specialty stores also sell personal computers. Although these stores may have competitive prices and attentive sales staffs, they are not as well equipped as the specialty computer stores to back up the computers they sell.

Mail/Phone Order Houses

Although some manufacturers of personal computers have been trying to crack down on the distribution of their computers through mail or phone order houses, these outlets still do a booming business, primarily because the computers they sell are heavily discounted.

Although mail/phone order houses are often a good way to shop for computers, there are some potential dangers for customers. For example, if your computer is damaged in transit or needs service, you want to be sure that you can get help, even if the supplier is thousands of miles away. If the supplier is a small operation without much experience in business, then you may be taking a risk. In addition, the mail/phone order houses obviously offer very little service or support.

Living-Room Dealers

A number of people around the country conduct successful cottage industries selling Commodore 64s and other popular personal computers literally out of their living rooms, at substantial savings to their customers.

Some of these dealers tread shaky legal ground, and you, the purchaser, may face problems down the line. In addition, these dealers rarely have the resources to give you service or support, although they often follow up to the extent of answering your questions (or peddling the latest software package).

If you know what you're doing and plan to get an independent service contract anyway, then the living-room dealers may have just the right deal for you. But caution is the watchword when you buy out of someone's living room.

Is Your Dealer an Authorized Commodore Dealer?

Commodore's system for authorizing dealers imposes various requirements, including staff training, availability of Commodore products, standard pricing schedules, and other criteria.

Although the authorized dealer stamp of approval is significant, it should not be your sole determining factor in choosing a dealer. For example, dealers not authorized by Commodore may provide excellent service and support and have extensive training in the repair of Commodore products. However, only authorized Commodore dealers are provided with certain parts that may be necessary for repairs.

What Kind of Service Does Your Dealer Offer?

Computer dealers, even authorized Commodore dealers, differ widely in type and quality of service they offer. So it's a good idea to find out the extent of your dealer's service offerings before you buy a system. Even if you've already bought it, you should find out what your dealer can and can't do for you.

This section discusses factors that affect dealer service, including staff expertise and training, parts inventory, repair prices, service contracts, length of repairs, and a number of other issues you can raise with your dealer.

Probably the most important service issue to raise with your dealer is whether he or she has the resources to handle the kinds of hardware and software problems you might encounter in operating your Commodore 64 system. Many dealers mean well but simply don't have the resources to cope with even everyday repair and maintenance problems.

Technical Staff

Most dealers talk in somewhat grandiose terms, about their "staff of technicians" or their "repair staff." Who are these mysterious "staff members," most likely cloistered in the back room, away from the prying eye of the public? In many cases, the much-vaunted repair staff turns out to be one technician, frequently a young man still wet behind the ears with not too much training and little going for him besides an enthusiasm for computers.

In fairness to youthful repair persons, however, some are bona fide computer whizzes who have built computers from scratch or written brilliant and innovative computer programs. Unfortunately, this kind of background doesn't always prepare them for the daily, grinding work of repairing personal computers.

The most prized qualities for a personal computer repair person are efficiency, a talent for diagnosing common problems, and an ability to communicate with the customer. You don't want brilliant, innovative answers to your hardware or software problems—you just want your computer fixed as quickly and cheaply as possible. Since efficient computer repair involves speedy diagnosis of the problem and then, usually, swapping of the defective parts, you want someone who can work fast and has a lot of experience with everyday problems.

The ability to communicate with customers is equally important. Many computer repair people, especially those who grew up in the computer age, think that everybody in the world knows what they're talking about when they bandy about such terms as *CPU, serial port,* or *expansion unit.*

Very few technicians, in fact, are able to tell customers clearly what repair was done on their systems and why. For that reason, technicians who can explain in plain English are highly prized. If you find such a rare person, hold on to him or her.

Although a single repair person might be able to handle the service load of a small dealership outside of a major urban area, most dealers need more than one repair person on staff or else significant outside resources, such as third-party maintenance companies, to back them up. For the average dealership, two or three full-time repair people are the minimum required to handle their service load.

Training is also an important part of a dealer's staff resources. If a dealer's technicians have had no training other than dedicated tinkering on their own personal computers, then they are not likely to have the professional approach required to repair and maintain your system competently.

If your dealer is authorized by Commodore, you can be pretty sure that his or her staff has met the requirements for training in Commodore 64 equipment and repair. However, you might also inquire about the educational and work experience of the dealer's technicians. At the least, this question shows your great concern with support and service.

Inventory and Other Kinds of Manufacturer Support

A frustrating aspect of going to a dealer to get your computer fixed is long delays when parts must be ordered from the manufacturer. Parts can take weeks or even months (in the case of less popular brands than Commodore 64) to arrive.

Most authorized Commodore dealers and repair companies will choose to swap elements of your system rather than spend time repairing them. Repair can be more expensive than simply replacing the unit. Generally, these dealers can replace components of your system immediately for a small service charge.

In both swapping and ordering of parts for repair, authorized Commodore dealers may have an advantage over dealers who don't have the official Commodore seal of approval. In theory at least, the authorized Commodore dealers have an inside track on parts ordering and other, more subtle forms of support, such as regular repair and maintenance updates and hotlines.

However, the size of a dealership may be just as important as its authorized status. Large dealerships who focus on customer service and support can afford to carry fairly large inventories of spare parts and boards for swapping. A large inventory means fewer delays per repair. In addition, larger dealers are often in a better position to carry non-Commodore parts for printers and other peripherals, which might take months to get from the manufacturers. This can be a major time saver if your printer suddenly starts belching smoke.

Repair Time

It is perfectly reasonable to ask your dealer how long it takes, on the average, to complete certain repairs. For example, how long for a simple board swap? What about finding a part for a printer or adjusting your disk drive?

Most dealers have a pretty good idea how long these repairs take, since they make hundreds of common repairs each year. In addition, some dealers are able to guarantee a repair time for most repairs, so you know what to expect.

Repair time can be crucial, especially if you rely on your computer system for work or for meeting deadlines. And dealers, like other service providers, compete to make repairs as quickly as possible.

For the third-party national service companies, twenty-four hour repair times have become the standard to meet. Although few dealers can compete with this standard, it is a good measure for comparison.

Prices

Prices for dealer repairs range from $50 per hour on up. If you bring your system into the dealer's shop you pay less per hour than if the technician comes to your home or office to fix it. In fact, many dealers simply do not offer on-site (at your location) repairs.

You are entitled to a written estimate of charges for parts and labor, and you should ask for one. You should also discuss the "repair or swap" options before the repair is made. For most Commodore repairs, it is much cheaper to swap the component than to repair it.

"Foreign" and "Mixed Vendor" Systems

Simply stated, "foreign" elements are non-Commodore hardware, such as a non-Commodore monitor, printer, or other component. "Mixed vendor" systems contain both Commodore and non-Commodore elements. Dealers may balk at servicing foreign elements or mixed vendor systems, although they are more of a problem in manufacturer service contracts. Mixed vendor systems don't usually pose a problem for dealers, however, particularly if the foreign elements are popular printers, monitors, or other peripherals. This is especially true if the dealer sold you the non-Commodore element in the first place.

Before you buy, however, it is a good idea to ask dealers whether they will service your non-Commodore hardware. Furthermore, you should find out what service you can expect for your non-Commodore hardware. If you have to wait three months to get your printer fixed, it might be wise either to buy a different kind of printer or to arrange for someone else to service your printer.

Finger Pointing

Finger pointing is the mutual assigning of blame by hardware and software vendors or by different hardware vendors. Dealers do as much finger pointing as anyone else in the repair and maintenance business. Dealers are likely to blame the software if they can't fix the hardware (or the non-Commodore hardware component if they can't discover what's wrong with the Commodore components).

Or the dealers may use the finger-pointing game as a way to explain their own delays or incompetence. For example, dealers may say that they've talked to both hardware and software vendors, and that both blame the other. Or Commodore may blame a non-Commodore manufacturer, and vice versa. What is the poor dealer supposed to do?

The answer is that the dealer is supposed to fix the problem, plain and simple. If this means going by trial and error until the problem is diagnosed, then the dealer should do that. Or the dealer should simply admit that he or she can't solve the problem and send it along to someone who can, either at Commodore or at an independent service company.

Above all, the finger-pointing game should not become an excuse for passing the buck and covering up deficiencies in the dealer's own repair resources and technical staff. As the customer, you have the right to insist that the problem be solved, no matter who is to blame.

Repair versus Swap

For most problems with Commodore 64 hardware, it is better to swap the defective element for a new one than to repair it. This can be done either through Commodore or your dealer.

However, for particularly expensive equipment requiring only a simple repair or adjustment, it is preferable to repair the unit. For this reason, you should at least check with your dealer before he or she automatically swaps the unit, since it may be cheaper to make the repair.

Finally, it's a good idea to find out what the dealer is charging you for parts or system elements. A dealer may charge much more than you would pay on the open market for a comparable Commodore or generic component. Even if you go along with the decision to swap, your interested inquiry may encourage the dealer to drop the price somewhat.

Back-Door Servicing

Back-door servicing is the dealer practice of passing repair jobs out the "back door" to the manufacturer or to an independent service company for repair. Although there is nothing illegal about this practice, it may mean service delays and misleads the customer, who thinks the dealer is doing the work.

Many dealers like to create the impression that they are totally in control of the repair and maintenance situation when, in fact, they can't begin to handle all the service requirements of their customers. It is more reputable to tell customers that their systems are being serviced off the premises by Commodore or by an independent service company.

Dealer Service Contracts

Dealers service Commodore 64 computers on either a contract or per repair basis. The service contract is essentially an insurance policy on the operation of your Commodore 64 system. If something goes wrong with the system, your dealer will fix it for free, with no charge for parts or labor.

Service contracts are not cheap. Prices vary depending on the type of system and its components. However, a rough estimate is 10 percent of the price of the system annually. Thus, if you spend $1000 for your system, a service contract costs approximately $100 per year.

The service contract may be a wise investment if you use your system a lot, depend on its smooth operation, and need rapid repair and regular service. However, most Commodore 64 owners don't need a service contract because Commodore's factory service plan is reasonably priced and because most dealers swap system elements for a modest service charge.

Appendix A

Troubleshooting Charts

Console Troubleshooting Chart

I. There is no power.

Diagnosis	Treatment
Defective or loose switches, cords, or plugs	Check that all switches are on, plugs are inserted, and cords are intact.
Household power supply problem	Check household voltage; if problems, install surge protector.
Console power supply problem	Check voltage readings on system, replace power supply.
System board problem	Check and replace parts or entire board.

II. The system operates for a while, then dies.

Diagnosis	Treatment
Defective or loose switches, cords, or plugs	Check that all switches are on, plugs are inserted, and cords are intact.

II. *(Continued)*

Diagnosis	**Treatment**
Household power supply problem	Check household voltage; if problems, install surge protector.
Console power supply problem	Check voltage readings on system, replace power supply.
System board problem	Check and replace parts or entire board.

III. The system stops but still has power.

Diagnosis	**Treatment**
Environmental source	Check for static electricity.
Software problem	Check for damaged disks or software bugs (swap software).
Household power supply problem	Check household voltage; if problems, install surge protector.
Console power supply problem	Check voltage readings on system, replace power supply.
System board problem	Check and replace parts or entire board.

IV. The system operates but crashes when you attempt an operation or turn on a peripheral.

Diagnosis	**Treatment**
Software bug	Check for software bugs (swap software).
Peripheral problem	Disconnect peripheral and test system.
Household power supply problem	Check household voltage; if problems, install surge protector.
Console power supply problem	Check voltage readings on system, replace power supply.
System board problem	Check and replace parts or entire board.

V. The system operates smoothly, then begins to behave erratically.

Diagnosis	Treatment
Software bugs	Check software.
Environmental source	Check for static electricity.
Household power supply problem	Check household voltage; if problems, install surge protector.
Peripheral problem	Remove and test system.

VI. There is garbage on the screen.

Diagnosis	Treatment
Household power supply problem	Check household voltage; if problems, install surge protector.
Console power supply problem	Check voltage readings on system, replace power supply.
Peripheral problem	Remove and test system.

VII. The computer is overheating.

Diagnosis	Treatment
Blocked ventilation outlet	Check for foreign object, dust, etc.

Keyboard Troubleshooting Chart

I. Nothing happens when you press a particular key.

Diagnosis	Treatment
Dirty key contact	Clean keyboard.
Chip failure	Substitute chips or get professional repair.

II. When you press a particular key, two characters appear instead of one.

Diagnosis	Treatment
Dirty key contact	Clean keyboard.
Chip failure	Substitute chips or get professional repair.

III. The keyboard produces junk on the screen.

Diagnosis	Treatment
Stuck key	Remove and clean.
Bad cable	Check cable.
Chip failure	Substitute chips or get professional repair.

IV. The keyboard suddenly locks.

Diagnosis	Treatment
Bad cable	Check cable.
Stuck function key	Remove and clean.
Software bugs	Check software.
Environmental source	Check for static electricity.
Household power supply problem	Check household voltage; if problems, install surge protector.
Chip failure	Substitute chips or get professional repair.

Video Monitor Toubleshooting Chart

I. There is no video display.

Diagnosis	Treatment
Loose or defective power cords, cables, plugs	Check that all are properly inserted and intact.
Improperly set brightness and other controls	Adjust controls.

System board failure	Swap monitors; replace if defective, otherwise test system board functions.

II. The video display fades in and out.

Diagnosis	Treatment
Improperly set brightness or other controls	Adjust controls.
Environmental source	Correct or wait until it subsides (e.g., electrical storm).
Household power supply problem	Check household voltage.
Faulty tube or other monitor element	Swap monitors; if faulty, take for professional repair.
System board failure	Check with diagnostic software.

III. The monitor is overheating.

Diagnosis	Repair
Clogged or blocked ventilation outlet	Clean or unblock outlet.
Monitor	Swap, then take for repair.

Disk Drive Troubleshooting Chart

I. The system has power, but the drive doesn't respond to commands.

Diagnosis	Treatment
No power to drive	Check household power supply; if intermittent problems, install surge protector.
	Check for environmental interference.
	Test power to drive; if problem, check system power supply.
Bad disks	Check disks for damage.

I. *(Continued)*

Diagnosis	Treatment
Bad software	Check software (change copies, programs).
Failing motor	Check drive belt, motor functions.

II. The drive operates but will not boot.

Diagnosis	Treatment
Bad software	Check software.
Misalignment	Get professional repair.
Incorrect motor speed	Adjust motor speed.
Faulty drive belt	Replace drive belt.
Failing motor	Check motor functions, replace motor.

III. The disk drive works but makes noise.

Diagnosis	Treatment
Improperly inserted disk	Check disk.
Copy-protected disk	Wait several seconds; if sound continues, check software.
Blocked or jammed drive	Check for foreign objects.
Improper motor speed	Adjust motor speed.
Misalignment	Get professional repair.

IV. The disk drive has read/write problems.

Diagnosis	Treatment
Bad disks	Check disks for physical damage.
Bad software	Check software.
Bad cables or cords	Check for damage, incorrect insertion.
Power supply problem	Check household power supply or environmental sources. Then check voltage readings to drive.

Dirty read/write head	Clean head.
Read/write head problems	Check read/write ability with diagnostics; if necessary, replace head.
Improper motor speed	Check motor speed.
Misalignment	Get professional repair.
Bad controller and interface ICs	Substitute chips.

V. It is difficult to insert and remove disks.

Diagnosis	Treatment
Bad disk	Check if disk is bent.
Latch problem	Replace latch.
Loose part	Check for loose screw or part.
Foreign object	Check for foreign object in drive.

Cassette Drive Troubleshooting

I. The cassette drive doesn't work at all.

Diagnosis	Treatment
Loose or defective plugs and cords	Check that they are properly inserted and not defective.
Household power supply problem	Check wall outlet.
Jammed drive	Check for foreign objects, jammed mechanism.
Dead motor	Get professional repair.

II. The cassette drive works but makes noise or operates slowly.

Diagnosis	Treatment
Twisted cassette tape	Check and repair.
Jammed drive	Check for foreign objects, jammed mechanism.
Failing motor	Get professional repair.

III. The cassette drive has input or output problems.

Diagnosis	Treatment
Bad cassette	Swap cassette.
Loose or defective cable to drive	Check cable.
Dirty tape head	Clean head.
Misalignment	Get professional repair.

Printer Troubleshooting Chart

I. Nothing happens when you turn the printer on.

Diagnosis	Treatment
Loose or defective switches, cords, or plugs	Check that all switches are on, plugs are inserted, and cords are intact.
Bad printer fuse	Check and replace fuse.

II. The printer has power but doesn't operate or perform the self-test.

Diagnosis	Treatment
Loose or defective switches, cords, or plugs	Check that all switches are on, plugs are inserted, and cords are intact.
Console problem	Disconnect printer and test system.

III. The printer performs the self-test but doesn't print on command.

Diagnosis	Treatment
Ribbon or paper problem	Check ribbon and paper.
Carriage or other mechanical problem	Check for proper function, placement.
Defective or loose cable	Check cable.

Interface problem	Check baud rate and other interface settings.
Software bugs	Swap software.

IV. The printer prints junk.

Diagnosis	Treatment
Interface problem	Check baud rate and other interface settings.
Software bugs	Swap software.
Console problem	Remove printer and check system.

V. The printer makes random errors.

Diagnosis	Treatment
Defective or loose cable	Check cable.
Software bugs	Swap software.
Dirty print heads	Clean printer.
Household power supply problem	Check for transients.
Console or drive problem	Swap printer; if problems remain, then other component is at fault.

VI. The printer functions smoothly, then suddenly stops.

Diagnosis	Treatment
Defective or loose cables	Check for proper insertion.
Printer error	Check for alarm light or error message.
Software bugs	Swap and check for bugs.
Interface problem	Check baud rate and other interface settings.
Household power supply problem	Check for transients.
Console or drive problem	Swap printer; if problems remain, then other component is at fault.

VII. The print carriage doesn't move at all.

Diagnosis	Treatment
Jammed carriage	Check for foreign object, loose parts.
Defective or loose cable or cord	Check for proper insertion.
Interface problem	Check baud rate and other interface settings.
Console problem	Swap printer, check.
Defective carriage	Replace carriage.

VIII. The printer operates but doesn't print.

Diagnosis	Treatment
Faulty ribbon	Check ribbon for placement and advance.
Print head problem	Check that print head is operating; clean, adjust, or replace.

IX. The printer is overheating.

Diagnosis	Treatment
Blocked ventilation	Check outlet.
Jammed print head	Clean or replace.
Malfunctioning printer circuits	Get professional repair.

X. The printing is uneven.

Diagnosis	Treatment
Worn ribbon	Replace ribbon.
Dirty print head	Clean print head.
Misaligned platen	Align printer platen.

XI. Characters or parts of characters are missing.

Diagnosis	Treatment
Ribbon out of place	Check and adjust.
Dirty print head or hammer	Clean.
Faulty ribbon mechanism	Replace.

XII. The paper jams or doesn't feed properly.

Diagnosis	Treatment
Paper problem	Check for correct loading; if tractor feed, turn off friction feed.
Jammed printer	Check for dirt or foreign objects; if OK, get professional repair.

Appendix B

Manufacturers

The following is a selected list of manufacturers of various products described in this book.

Manufacturer	**Product(s)**
Bell Industries J. W. Miller Division 19070 Reyes Ave. Rancho Dominguez, CA 90224	Power protection
Cuesta Systems 3440 Roberto Court San Luis Obispo, CA 93401	Power protection
Curtis Manufacturing 305 Union St. Peterborough, NH 03458	Power protection
Datashield 320 River St. Santa Cruz, CA 95060	Power protection
Dysan Corporation 5201 Patrick Henry Dr. Santa Clara, CA 95050	Diagnostic software, drive-cleaning kit

Electronic Protection Devices P.O. Box 673 Waltham, MA 02254	Power protection
Electronic Specialists 171 S. Main St. Natick, MA 01760	Power protection
Falcon Safety Products 1065 Bristol Rd. Mountainside, NJ 07092	Antistatic products
General Electric 225 Service Ave. Warwick, RI 02886	Power protection
Inmac 2465 Augustine Dr. Santa Clara, CA 95051	Drive-cleaning kits
Kalgo 6584 Ruch Rd. Bethlehem, PA 18017	Power protection
Micro Software The Silk Mill 44 Oak St. Newton Upper Falls, MA 02164	Diagnostic software
Panamax Corporation 150 Mitchell Blvd. San Rafael, CA 94903	Power protection
PMC Industries 9353 Activity Rd. San Diego, CA 92126	Power protection
RKS Industries 4865 Scotts Valley Dr. Scotts Valley, CA 95066	Power protection
SGL Waber Electric 300 Harvard Ave. Westville, NJ 08903	Power protection

Sutton Designs, Inc. 111 S. Cayuga Ithaca, NY 14850	Power protection
Verbatim Corporation 323 Soquel Way Sunnyvale, CA 94086	Diagnostic software, drive-cleaning kit
Wright Line, Inc. 160 Gold Star Blvd. Worcester, MA 01606	Power protection
3M Data Recording Products 3M Center Bldg. Saint Paul, MN 55144	Drive-cleaning kits

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Ithaca, NY 1485

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First the Bad News

Sooner or later **something will go wrong** with your Commodore 64® series computer (Murphy's Law). Owners annually spend up to 20% of their system's purchase price on maintenance and repair.

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Average, non-technical owners like you can fight back! **Micro Doctor** shows you how to **prevent** 90% of typical problems in the first place and how to **repair** 50% of the problems that do crop up. You can save up to 75% on annual repair bills in the bargain.

Proper Care

Section I of this book supplies specific advice on how to minimize the risk of hardware failure. You'll learn how to set up and maintain the proper physical environment, how to insure an even and steady flow of power, how to clean and protect each system component, and how to prevent accidental damage.

Simple Troubleshooting and Repair

Section II describes the precise steps you should take at the first hint of trouble. Using the medical diagnosis format (symptoms, possible causes, what to check, corrective actions to take) these chapters cover each of the Commodore 64 components and their likely problem spots. Explicit instructions show you how to isolate the cause of a problem and fix it with everyday household tools. You don't need experience in electronics or fancy tools and test equipment to succeed. You will save time and money.

Service Options

Section III discusses service alternatives in the event that you discover a serious problem. This section provides tips on what to look for (and what to avoid) in your dealer's service plans, Commodore's warranties and service offerings, and third-party repair options.

In plain down-to-earth English, this common-sense guide supplies the practical information you need to handle any problem with confidence. The first and best defense against glitches, gremlins, and other unpleasant surprises, **Micro Doctor** is an indispensable deskside consultant. **Micro Doctor** pays for itself when it saves you that first service call.

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